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EAST MARGINAL WAY PUMPING STATION

OPERATION AND MAINTENANCE MANUAL

METRO
MUNICIPALITY OF METROPOLITAN SEATTLE

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EAST MARGINAL WAY PUMPING STATION

OPERATION AND MAINTENANCE MANUAL

Copy No. 006

METRO
MUNICIPALITY OF METROPOLITAN SEATTLE

Prepared by Milmanco Corporation
Renton, Washington

JUNE 1978

FOREWORD

This manual is a guide for operating and maintaining the East Marginal Way pumping station. The level of information is sufficient for operation of the pumping station by Grade 4 operators and maintenance of plant equipment by qualified personnel. It does not preclude the use of other data to provide a more rapid solution to specialized operational or maintenance problems (with approval in advance at the appropriate supervisory level).

This manual is divided into 12 sections plus appendices. Section I briefly describes the station and defines its relationship to the entire Metro system. Sections II and II provide safety and administration and maintenance procedures. Sections IV through XII are system descriptions and operating procedures in the following format:

PHYSICAL DESCRIPTION

Identifies and locates the major equipment in each system and provides equipment characteristics tables. The text is supplemented by photographs and/or distribution diagrams to facilitate identification.

FUNCTIONAL DESCRIPTION

Provides, to a major component level, the system's theory of operation. Alarms and system controls and indicators are related to the functional description, when applicable. The text is supplemented by block or line diagrams as required.

OPERATIONS CHECKS

Identifies system alarm indications, operator-performed adjustments and operator services. Alarm indications for all pertinent system alarms are listed, as well as actions to be taken to correct the fault. Procedures are provided for equipment requiring operator adjustments. Tables are included listing periodic checks and services that must be performed by operators to keep the equipment in peak operating condition.

OPERATING PROCEDURES

Provides step-by-step operating procedures required to start, stop, and run each system in its various operating modes. For identification, operating controls and indicators are referenced to the physical description photographs.

There are four appendices:

Appendix A – Glossary of water pollution control terms

Appendix B – Index of station construction contracts and engineering drawings

Appendix C – English-Metric conversion table

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SECTION I
GENERAL INFORMATION

INTRODUCTION

The East Marginal Way pumping station (figure 1-1) is in the city of Seattle at 7319 East Marginal Way South. The station pumps wastewater through the Elliott Bay interceptor for transport to the West Point Treatment Plant (WPTP).

The pumping station compensates for terrain variations that affect the sewage flow rate along the interceptor route. The facility houses three raw sewage pumps and related equipment required to lift the sewage about 23 feet (7.0 m) above the pump suction conduit invert, maintain an adequate flow rate, and minimize settling in the sewer lines. Such settling could significantly reduce the storage capacity needed during emergency or storm conditions.

The station is unmanned and fully automatic with provisions for manual operation during maintenance or if automatic controls fail. Odor, noise, and environmental impact are minimal.

METRO SYSTEM RELATIONSHIP

Figure 1-2 shows the location of the East Marginal Way pumping station and its relationship to other Metro facili-

Figure 1-1. East Marginal Way Pumping Station

ties. The station is part of the Elliott Bay interceptor and is between interceptor sections 1 and 2. Station flow derives primarily from two sources: from the east through the Henderson Street trunk and Norfolk Street regulator station, and from the south. The south component of the flow includes sludge from the Renton treatment plant. The sludge travels through twin force mains that connect to interceptor section 1 at the Seelye connection downstream of the regulator station (figure 1-3). From the Norfolk Street regulator station to just upstream of the East Marginal Way facility, the interceptor consists of two parallel lines (figures 1-3 and 1-5). The dual configuration increases interceptor capacity between the stations; the lines are cross-connected just downstream of the regulator station. From the East Marginal Way facility, flow continues through the length of the Elliott Bay interceptor to the North interceptor, and on to the WPTP. Since all raw and activated sludge from the Renton treatment plant passes through the station on its way to WPTP for treatment, continuous and efficient operation of the facility is critical to avoid odor, sepsis, and overflow problems.

SERVICES PROVIDED

The East Marginal Way pumping station serves an area (figure 1-3) of 3,975 acres (1,609 ha). This includes part of the west side of Lake Washington, Columbia City, the south side of Beacon Hill, the Boeing industrial complex, and the area south of the Boeing complex to the Seelye Connection.

FACILITY DESCRIPTION

The East Marginal Way pumping station consists of a three-level (figure 1-4) control building, an underground effluent junction structure and two special manholes. Table 1-1 lists major station characteristics.

Control Building

On the rectangular ground level of the control building are the control room and access areas leading to the two lower levels. The motor room, pump room, and wet well are all below ground level inside a caisson foundation. A watertight wall goes down through the lower levels sealing the wet area of the building from the dry. Spiral stairways connect the control room to the wet well on the wet side and the pump and motor rooms on the dry side. At the center of the control building roof is a rain gage that is the operational and maintenance responsibility of the City of Seattle.

Control Room. The control room is entered through either the personnel or equipment door (figure 1-1). In the control room are the electrical switchgear, motor control center, main control panel, support systems, and climatic control equipment. A 6-foot (1.8 m) square hatch for equipment installation and removal opens to the motor room below. On the southeast wall are a 460-volt receptacle for connection of a mobile emergency generator, the irrigation sprinkler controller, power panelboard "A", and the CATAD and Metrotel telemetry cabinets. On the wet well access stairwell landing are the wet well exhaust fan and the influent gate system manual pressurization pump.

Motor Room. This room houses the three raw sewage pump drive units and the pump room transfer fan. Over each drive unit is a monorail beam on which a trolley hoist can be suspended. A floor grating facilitates pump room equipment installation and removal. On the wall near each drive unit is a TEST/STOP-lockout control station.

Pump Room. The pump room houses the three raw sewage pumps (RSP). On the wall behind each pump are a C2 seal water manifold and TEST/STOP-lockout control station. Near RSP 3 is the sump drainage subsystem including the pump room flood alarm float switch.

Wet Well. Major equipment in the wet well are the influent sluice gate and hydraulic operator and the bar screen. On the wall behind the stairway is the sluice gate mode controller (manual operator). At the influent channel are the wet well high level float switches and the influent sluice gate pilot control float. A slide gate can be installed at the wet well end of each pump suction conduit to isolate the unit for maintenance or repair. At the watertight wall above the grating over the RSP 1 inlet conduit are two explosive gas sensors.

Effluent Junction Structure

The effluent junction structure is about 20 feet (6.1 m) north of the control building. The three station force mains enter the structure from the south, discharging wastewater through flap valves into a common channel. The structure can be entered through a manhole at each end (one is inside the security gate and one is outside). A slide gate can be installed downstream of each flap valve (see figure 1-5) after removing the respective lift slab (see figure 1-1). Elliott Bay Interceptor section 2 begins as the 54-inch (137-cm) line that exits the northwest end of the junction structure.

Special Manholes

Both the overflow and storm drain manholes are east of the control building; the overflow manhole is the nearer of the two. The 60-inch (152-cm) influent sewer runs through the bottom of the overflow manhole to the wet well (see figure 1-5). Sixteen feet (4.9 m) above the influent sewer line invert (elevation 92.93), a 36-inch (91-cm) overflow line connects the overflow manhole to the storm drain manhole

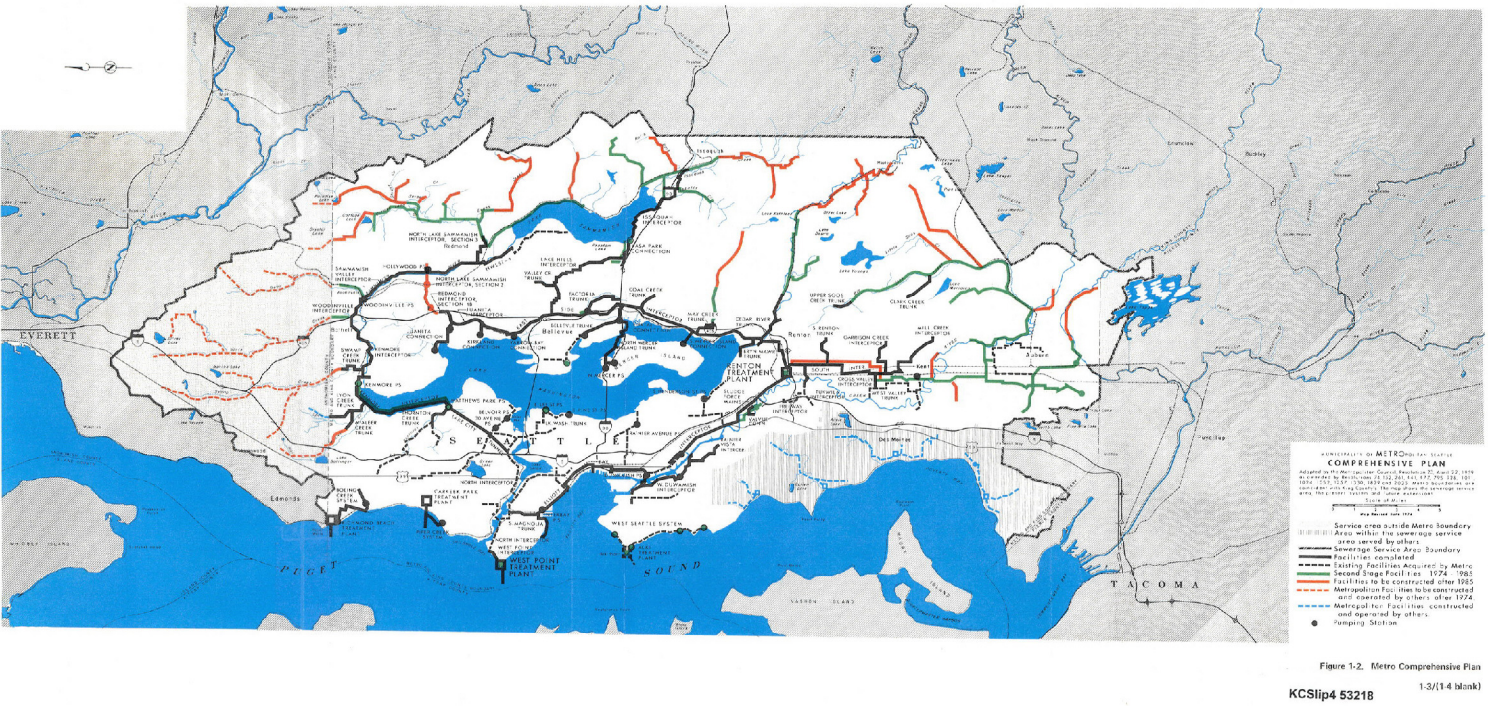

Figure 1-2. Metro Comprehensive Plan

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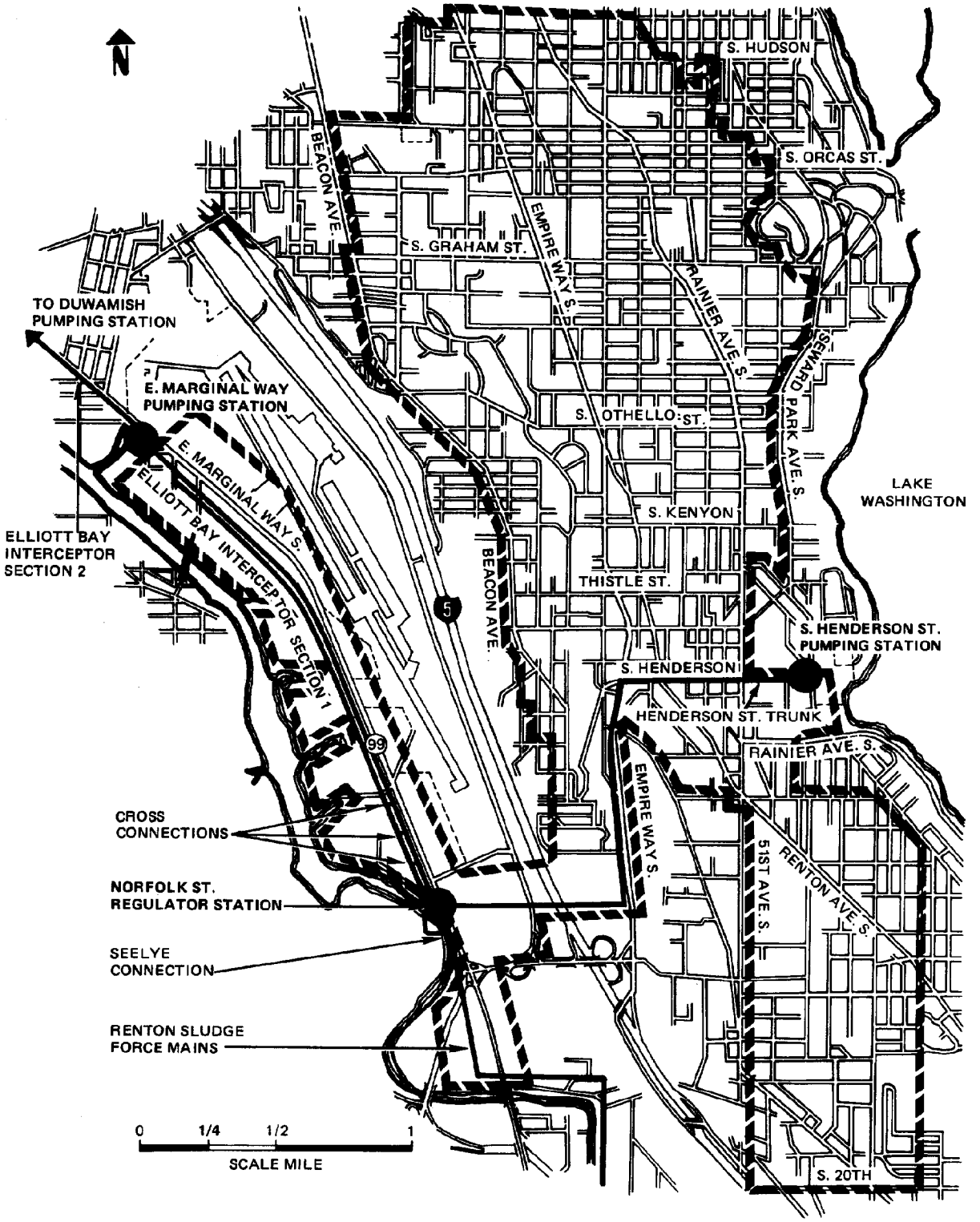

Figure 1-3. East Marginal Way Pumping Station Tributary Area

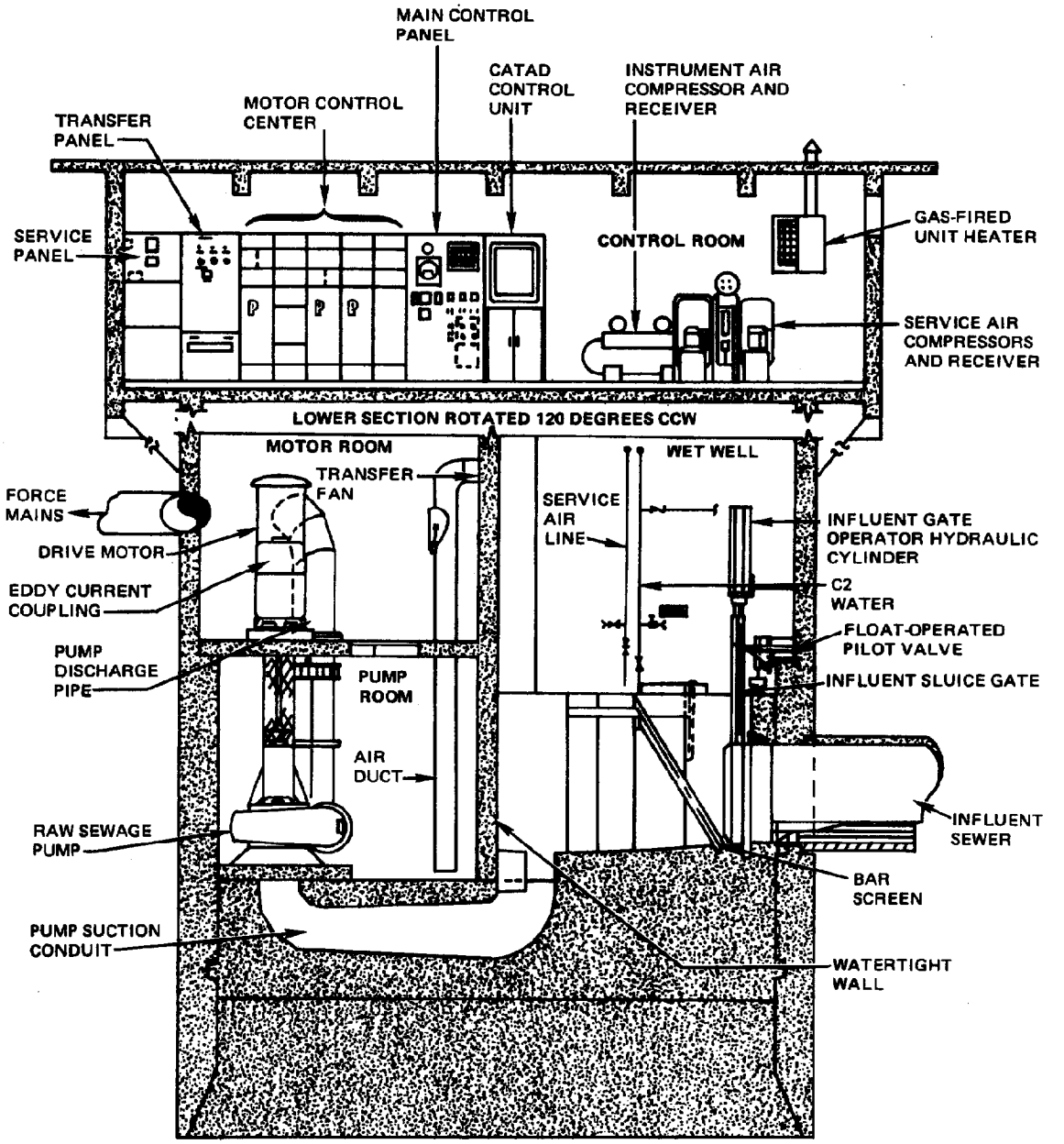

Figure 1-4. Pumping Station Cross Section

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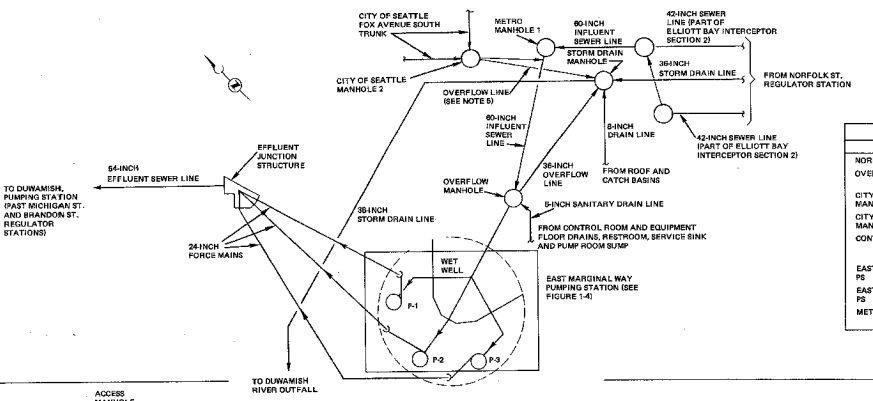
NOTES

1. SEWER LINE DESIGNATIONS ARE UNOFFICIAL AND PERTAIN TO THIS DRAWING ONLY.
2. 24-INCH FORCE MAINS ARE CEMENT-LINED AND COATED. SEWER LINES SHOWN ARE REINFORCED CONCRETE. 36-INCH OVERFLOW LINE IS CORRUGATED METAL.
3. ELEVATIONS SHOWN ARE REFERENCED TO METRO DATUM (SEA LEVEL + 100 FT.).
4. CITY OF SEATTLE FOX AVENUE SOUTH TRUNK IS NOT SHOWN ON HYDRAULIC PROFILE.
5. MH 2 OVERFLOW ELEVATION IS 2 FEET (0.6 m) HIGHER THAN STATION ELEVATION AND PRECLUDES FLOODING OR BACKUP ALONG THE TRUNK FROM STATION SURCHARGES.



DISTANCE TABLE		
FROM	TO	DISTANCE, FT(m)
NORFOLK ST. RS	WET WELL	10,130 (3,090)
OVERFLOW MANHOLE	STORM DRAIN MANHOLE	23 (7.0)
CITY OF SEATTLE MANHOLE 2	INFLUENT SEWER	15 (4.6)
CITY OF SEATTLE MANHOLE 2	STORM DRAIN MANHOLE	35 (10.7)
CONTROL BUILDING	EFFLUENT JUNCTION STRUCTURE	15 (4.9)
EAST MARGINAL WAY PS	MICHIGAN ST. RS	4,280 (1,305)
EAST MARGINAL WAY PS	DUWAMISH PS	11,445 (3,490)
METRO MANHOLE 1	OVERFLOW MANHOLE	55 (16.8)

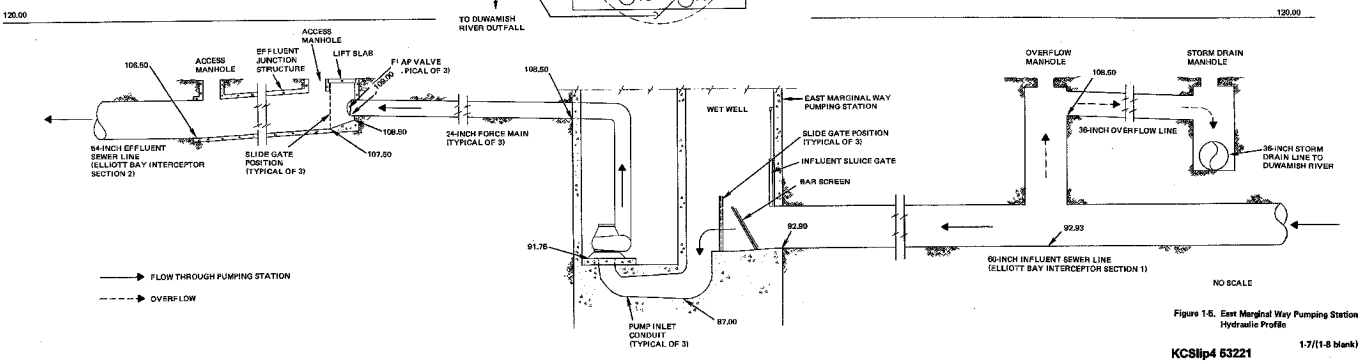


Figure 1-5. East Marginal Way Pumping Station Hydraulic Profile

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15 feet (4.6 m) away. The storm drain manhole is atop a 36-inch storm drain line that runs parallel to East Marginal Way 3 feet (0.9 m) above the influent sewer.

Table 1-1. Pumping Station Characteristics

PUMPING CAPACITY

Average dry weather flow: 16.8 mgd (63,588 cu m/day)

Maximum wet weather flow: 69.0 mgd (261.164 cu m/day

ELECTRICAL POWER REQUIREMENTS

460-volt, 3-phase, 60 Hz to control room switchgear from Seattle City Light. Emergency power supplied by mobile generator.

WATER REQUIREMENTS

1.5-inch (48-mm) service from Seattle Water Department

STATION HYDRAULICS

All wastewater enters the wet well from the east and 20 feet (6.1 m) below ground level (figures 1-2 and 1-5). In the wet well, wastewater is coarse-screened, lifted 23 feet (7.0 m) by the raw sewage pumps, and discharged through 24-inch force mains into the effluent junction structure. From the junction structure, wastewater flows by gravity past the Michigan Street and Brandon Street regulator stations through Elliott Bay interceptor section 2 to the Duwamish pumping station.

If the influent sewer line becomes surcharged from high flows, station shutdown, or equipment malfunction, the water in the overflow manhole rises. When the water level reaches elevation 108.50 [15.6 feet (4.8 m) above the influent sewer invert], it enters a 36-inch (91-cm) overflow line to the storm drain manhole. At the manhole, overflow drops into the storm drain line and flows to the outfall in the Duwamish River. Depending on flow and weather conditions, station storage times vary from 30 minutes to 4 hours before overflow occurs.

The City of Seattle Fox Avenue South trunk connects to the influent line about 60 feet (18.3 m) upstream of the station and overflows to the storm drain manhole also (figure 1-5). The trunk overflow elevation at City of Seattle manhole 2 (figure 1-5) is 2 feet (0.6 m) higher than the station overflow elevation which minimizes the chances of backups or local flooding along the trunk from station surcharges.

REGULATORY CONSIDERATIONS

Metro facilities come under the provisions of Public Law 92-500, the Federal Water Pollution Control Act of 1972. The law mandates regulation and monitoring of wastewater discharges into inland and offshore receiving waters.

NPDES Permit

Metro pumping stations are authorized sanitary sewer overflows and/or bypasses by the terms of section S7 of National Pollution Discharge Elimination (NPDES) Waste Discharge Permit Number WA-002918-1 for the WPTP issued by the Washington State Department of Ecology. The permit, subject to annual renewal, is available for reference at the Metro Water Quality Division, 410 West Harrison Street, Seattle, Washington 98119.

Overflow/Bypass and Spill Monitoring

Under the terms of the permit, overflows and bypasses must be monitored, and also the effluent from industrial users discharging measurable quantities of toxic materials or more than an average of 50,000 gallons per day (190 cu m/day), to ensure maintenance of high water quality. Both are the responsibility of Metro's Water Quality Division. Normally, overflow and bypass points are automatically checked through the Metro Computer Augmented Treatment and Disposal (CATAD) system (refer to Metro Operation and Maintenance Manual TSD-1). If an overflow occurs, technicians are immediately dispatched to the site to take samples for laboratory analysis. Industrial users meeting the discharge criteria are checked annually as a minimum or as necessary to ensure compliance with water quality limitations. Copies of applicable federal and state laws and/or regulations on spills are available at the Water Quality Division office.

Bypassing, overflows, and spills must be reported promptly and completely. Refer to Section III, Administration and Maintenance, for instructions on filling out Metro Form OP-40, Sewage By-passing or Overflow Report.

SAFETY

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SECTION II
SAFETY

INTRODUCTION

General

Safety at the pumping station conforms to standard Metro regulations and practices. Metro endeavors to provide safe working conditions and to promote safety consciousness among employees to eliminate accidents and personal injuries. To this end, the following approaches have been incorporated:

a. Metro's current safety program makes each individual responsible for effective safety practices and encourages active employee participation.

b. Each employee is issued a safety manual which describes potential hazards and the necessary precautions.

c. Accidents are reported according to standard procedures consistent with state and federal requirements. These accident reports provide a basis for subsequent investigation and elimination of the hazard.

d. A comprehensive safety policy is enforced by the following methods:

1. Each division has a Safety Coordination Committee (SCC) composed of representatives of management and employees. Each new employee is required to attend the first committee meeting after his date of hire. At this time, Metro and division policies regarding safety and first aid are explained to him.

2. Discussions among employees and safety personnel representatives are encouraged.

3. A training program ensures that all supervisors know the safety procedures thoroughly.

4. Every employee is issued, and carefully instructed in the use of, personal protective equipment.

Complete information about the organization and administration of the safety program appear in the West Point Operation and Maintenance Manual and in the West Point Division Safety Manual.

Safety Manual

The West Point Division Safety Manual was compiled to minimize injuries. The manual gives a guideline for safe operation and maintenance of Metro facilities. All employees receive pocket-sized editions, which are required reading, to familiarize them with the precautions necessary under hazardous working conditions. Additional copies of the manual are available in prominent locations throughout Metro plants. Suggestions or recommendations for improvements of division safety standards are submitted to an SCC representative. The manual will be revised, pending release of the WISHA (Washington Industrial Safety and Health Act, 1973) regulations.

Accident Reporting

Accident reporting procedures apply to personal injuries and vehicle accidents. Currently, accident reports covering personal injuries and vehicle accidents comply with state and federal requirements. WISHA and OSHA (Occupational Safety and Health Act, 1970, U.S. Department of Labor) regulations provide the guidelines to monitor the safety program. Review and analysis of accident reports, including followup actions, provide an orderly approach to hazard elimination.

The Metro First Aid Report, Form S-3, is required for any on-the-job injuries that require first-aid treatment with no attendant loss of job time. The Report of Injury, Form S-1, and the First Aid Report, Form S-3, are necessary for all injuries requiring a doctor's attention. In case of injury not requiring a doctor's service, an informal inquiry on the accident is held before the end of the shift or at the start of the next shift. The supervisor and two or three coworkers conduct the inquiry, and the report is forwarded to the Safety Director.

For on-the-job injuries requiring a doctor, the State of Washington form, Report of Accident (R 211580), is also used. Both the employee and doctor fill out this legal-sized form in triplicate. The doctor mails Part III of the white sheet to Olympia, keeps Part III of the yellow sheet, and mails the rest to Metro's main office for addition of employer's data and transmittal to the State Department of Labor and Industries.

When an accident involves a Metro motor vehicle or a privately owned vehicle used for Metro business, form Vehicle 2 REV. 5M 106803 must be filed. This form, together with witness forms, are stored in a manila envelope in the glove compartment of the vehicle. Phone Metro's Personnel Department at the main office as soon as possible. Reports must be filled out by an accident study group. The

MUNICIPALITY OF METROPOLITAN SEATTLE
FIRST AID REPORT

Date of Injury_____ Name_____
(Please print)
Time of Injury_____ AM PM Date of First Treatment_____ Time_____ AM PM
Nature of Injury_____
(Left eye, rt. foot, etc.)
Went to Doctor - Hospital - Home Phone No._____
Home - Stayed on job
(Circle one) Time Lost_____Days

What First Aid Received_____

Any Safety Suggestions_____

Date Reported to Supervisor _____ Injured's Signature _____

Form S-3
5/65
(over)

SUPERVISOR'S REPORT

Where Accident Occurred_____

Described what happened:_____

Safety Suggestion:_____

Division _____ Date _____ Supervisor's Signature _____

MUNICIPALITY OF METROPOLITAN SEATTLE REPORT OF INJURY

Name of Injured_____Age___Married_____
Date of Accident_____, 19___Hour_____AM PM Occupation_____
Where Accident occurred_____
Nature of injury_____
Was first aid administered?_____If so, by whom_____
Name & Address of Dr._____
Did injured leave work?_____Date_____Time_____AM PM
Name of witnesses_____
Where and how did accident occur? (Accident facts)_____
Was injured acting in regular line of duty?_____

SUPERVISOR'S REPORT

At a hearing of our accident study group, consisting of the men and supervisor listed below, we feel that the above accident was caused by the following reasons:

___Design of the structure ___Unsafe working conditions ___Unsafe act
___Other (Specify, name more than one reason if it exists)_____

The undersigned feel that future accidents of this type can be prevented by

Improving design (Specify what can be designed better and how)

Eliminating Unsafe Conditions (Specify what and how)

Eliminating Unsafe Acts (Specify)

Other (Specify):

Committee Member (signature) _____ Committee Member (signature) _____

Committee Member (signature) _____ Supervisor (Committee Chairman) (signature) _____

(See Reverse Side)

Form S-1
67 1-20

FOR FOREMEN OR SUPERVISOR'S EVALUATION

Please mark the reasons, in your opinion, for the accident occurring:

Supervisory Responsibilities	Personal Action or Characteristic of Employee
___No instructions given	___Haste or shortcuts
___Incomplete instructions	___Goggles, shields, etc., provided, not used
___Rules, standard, or instructions not enforced	___Improper or unsafe tools or equipment used
___Personal safety devices not provided	___Horse-play or fooling
___Correct or safe tools or equipment not provided	___Instructions or rules disregarded
___Inadequate inspection of equipment or jobs	___Inattention
___Improper method of doing work	___Inexperience
___Poor job planning	___Physical conditions of employee
___Too much rush	___Improper body position
___Selection of wrong type of employee for job	___Improper method of doing work
___Other	___Action of fellow employee
	___Improper clothing
	___Poor judgment
	___Other

Unsafe Equip. or Material	Unsafe Conditions
___Ineffectively guarded equipment	___Slippery surface
___Unguarded equipment	___Poor light
___Defective materials	___Poor ventilation
___Defective tools	___Congestion
___Defective equipment	___Improper storing
___Defective motor vehicle equipment	___Exits inadequate
___Other	___Faulty layout
	___Tools, equipment, materials scattered
	___No shoring
	___Improper shoring
	___Gases
	___Other

Received By:

1. _____
Division Head (signature)

2. _____
Director of Dept. (signature)

3. _____
Engineer, Safety & Special Services (signature)

This space reserved for use of safety personnel

Figure 2-1. Metro First Aid Report

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accident study group determines whether the accident was preventable or not. Witness slips should be used.

If a Metro employee is injured, he should follow previous instructions relating to personal injury reporting. If total damage to the vehicles or other property exceeds $100, or if personal injury requires the attention of a doctor, the driver must report within 24 hours to either the local police (if the accident occurred in an incorporated city or town), or to the Sheriff's Office or State Patrol if the accident occurred in unincorporated territory.

Basic Causes of Accidents

Experience shows that the basic causes of accidents at wastewater plants are:

a. Failure of the person in charge to:

1. Give adequate instructions.

2. Make thorough inspections and investigate follow-up action.

3. Assign safety responsibilities.

4. Check equipment and safety devices before commencing tasks.

5. Plan safety procedures for proposed activities.

6. Use safe methods and follow safety rules.

7. Use experienced or skilled employees.

8. Maintain discipline and enforce safety rules.

9. Require reasonable working hours.

b. Failure of employees to:

1. Observe established safety rules and practices.

2. Use equipment at rated speed or follow other instructions.

3. Get permission to perform work not regularly assigned.

4. Use protective devices or equipment.

5. Properly use tools, equipment, or materials suitable for the work to be performed.

c. The mental attitude or physical condition of employee, such as:

1. Divided attention or inability to concentrate.

2. Lack of knowledge or comprehension.

3. Failure to use good judgment.

4. Tendency to hurry a job or take hazardous short cuts.

5. Inability to work with others (anger or impulsive action).

6. Excitement, fright, and other involuntary reactions.

7. Physical handicaps or lack of strength.

8. Conditions caused by allergy.

9. Reduced human reliability due to environmental pollutants such as excessive noise or gas fumes.

General Precautions

The following general precautions are repeated throughout this manual at appropriate places.

Personal Injury Precautions. Operating and maintenance personnel must follow these rules to reduce chances of personal injury:

a. Observe safety regulations at all times.

b. Do not service electrical equipment alone. To avoid casualties, always remove power and ground a circuit before touching it.

c. Lock and tag motor controls to ensure that the motor cannot be energized while maintenance is being performed.

Equipment Damage Precautions. Strictly follow these rules to reduce chances of equipment damage:

a. When purging gages, do not allow water pressure to exceed capacity of gage.

b. Ensure that the EMERGENCY GENERATOR BREAKER switch is set to TRIP/OPEN before shutting down emergency generator.

PERSONAL HYGIENE PRECAUTIONS

Cleanliness is of critical importance to persons working in Metro facilities. Infection and disease are a constant threat to the employee and those with whom he associates. A number of diseases can be communicated by the solid waste that passes through the collection system, and eventually appears in wastewater, sludge, screenings, and scum. To avoid infection, protective clothing must be used. Coveralls are provided for all employees, and regular laundry service is available. Frequent uniform changes help prevent transmission of infection or disease to other persons. Work clothes should never be worn home.

After handling sewage or sludge, all exposed skin should be thoroughly washed. Protective waterproof dressings must be worn to prevent contact of open cuts or wounds with sewage, sludge, or contaminated equipment. But if there should be contact, wash the area thoroughly in clean water containing either a weak solution of disinfectant or a good antiseptic. Then sponge the area with an antiseptic solution and cover with a clean dry gauze dressing and waterproof adhesive. If penetration is more than superficial, see a doctor as soon as possible. In the event of deep wounds, the employee must get a tetanus booster within 48 hours. Bandages covering wounds should be changed frequently.

"Keep your hands below your collar" is a good rule to follow while at work in sewers and pumping stations and while handling sewage or sludge. Since many infections reach the body by way of the mouth, nose, eyes, and ears, the hands should be washed thoroughly before smoking, eating, or drinking.

Any illness or symptom such as dysentery or stomach pain should be reported to the supervisor immediately. An annual physical examination is recommended, and an annual eye examination is offered to each employee.

To assist in personal cleanliness and to prevent the transmission of infection, the toilets and washrooms are thoroughly cleaned and disinfected, soap dispensers are filled daily with germicidal soap, and paper supplies are replenished.

X-ray Program

Tuberculosis is no longer a major health hazard, but there is still a need for regular checkups, particularly for wastewater treatment plant employees. Chest X-rays are voluntary and are available free of charge through the Seattle-King County Health Department. Metro recommends regular use of this service.

Immunization Program

To provide protection against typhoid, polio, diptheria, and tetanus, a free immunization program is available to all divisional employees through the Seattle-King County Health Department. Immunization records (figure 2-2) for each employee are kept in the divisional safety files. Periodic screening of these records ensures that shots are updated as required.

OPERATING PRECAUTIONS

Metro strives to protect pumping station operators by providing good plant conditions and by informing employees of hazards inherent in sewage handling and effective safeguards.

Lighting

Adequate lighting is essential for maintenance/operations functions in buildings without windows or below ground. During a power failure, the essential services standby generator provides power for lighting.

When auxiliary lighting is required in flammable atmospheres such as sewers, use safety gasproof flashlights, and gasproof extension electric lights with heavily insulated cords. Ordinary flashlights or unprotected electric light bulbs are dangerous, because a spark from a switch or an exposed hot filament from a cracked bulb could ignite the gas.

Ventilation

The following measures are taken in the pumping station to ensure adequate ventilation:

a. Mechanical ventilation systems provide positive ventilation in areas with potential oxygen deficiency or explosive atmosphere. Portable blowers are used for manholes, sumps, wet wells, and submerged areas where temporary forced ventilation is needed to ensure a safe working atmosphere.

WARNING

Check with oxygen deficiency meter first. The explosive gas monitor will not work in an oxygen deficient atmosphere.

b. Tests for the presence of dangerous gases or an oxygen deficiency are made before work begins and every half hour after that.

METRO EMPLOYEE IMMUNIZATION RECORD

1. Polio 10 yr. renewal
2. Typhoid 3 yr. renewal
3. Diptheria & Tetanus 10 yr. renewal
4. Other

Call Health Department before leaving plant to notify them when and how many are arriving.

Public Safety Bldg. (Seattle) 583-2540

King Co. Health Dept. (Renton) 228-2620

RECORD CARDS WILL BE KEPT ON FILE AT:

NAME	#	Date of immunization												
	1													
	2													
	3													
	4													
	1													
	2													
	3													
	4													
	1													
	2													
	3													
	4													
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	3													
	4													
	1													
	2													
	3													
	4													
	1													
	2													
	3													
	4													

Figure 2-2. Sample Employee Immunization Record

c. While work is in progress, ventilation equipment operates continuously. Explosion-proof equipment and nonsparking tools are used to ensure that ventilation equipment does not ignite flammable gas. Employees must never work alone in a potentially dangerous atmosphere.

Hazardous Gases and Vapors

Toxic or suffocating gases may come from industrial waste discharges or from the decomposition of wastewater. Since noxious gases or vapors are harmful to human health, Metro employees must be aware of all potential gas hazards. At Metro, gas hazards divide into three classes:

a. Flammable (Class 1)

b. Suffocating (Class 2)

c. Poisonous (Class 3)

A noxious gas may belong in any one or all three of the above classes. For example, nitrogen is nonpoisonous, nonflammable, and falls into class 2, suffocating. Methane is nonpoisonous, but is flammable and suffocating, and falls into classes 1 and 2. Carbon monoxide is flammable, suffocating, and poisonous, and falls into classes 1, 2 and 3.

Sewage Sludge Gas and Sewer Gas. Sewage sludge gas is given off as a byproduct of the digestion of sewage sludge. It consists primarily of methane and carbon dioxide with smaller amounts of nitrogen, hydrogen, and hydrogen sulfide. Combustible gases (mostly methane) normally make up from 65 to 80 percent of the total volume of sewage sludge gas and noncombustible gases (mostly carbon dioxide) from 20 to 35 percent. Odor is an unreliable indicator of the composition of sewage sludge gas. Atmosphere testing devices must be used before entering an area that has a questionable atmosphere.

Hazards associated with sludge gas are:

a. Explosion or burning methane when oxygen is present to support combustion.

b. Asphyxiation resulting from insufficient oxygen to support life.

c. Direct poisoning by carbon monoxide (which is odorless) or hydrogen sulfide.

After a short time, the sense of smell is paralyzed by hydrogen sulfide, and a dangerous concentration may not be noticed.

Sewer gas (which includes a variety of gas mixtures) is found in sewers and sewer manholes. These areas may contain high percentages of carbon dioxide, varying amounts of methane, hydrogen, and hydrogen sulfide, and low percentages of oxygen. Normally the greatest danger comes from an oxygen deficiency or an explosive amount of methane. Such a mixture accumulates in sewers as the result of fermentation or decomposition of organic matter, especially in sewers constructed on nearly flat grades. Employees must be extremely careful when entering these areas.

Petroleum Vapors. Gasoline and petroleum vapors in the Metro sewer systems normally result from the accidental or illegal entry of gasoline and other hydrocarbons. Illegal entry of gasoline or petroleum does not happen frequently. However, the fire department must immediately wash down the street where gasoline or petroleum products were accidentally spilled. A washdown puts flammable products into the sewer system. Therefore, before any washdown, the fire department must notify the Main Control Center at WPTP and state the amount of gasoline or petroleum being washed down and the location of the washdown. The greatest hazard associated with petroleum product vapors is explosion. Refer to Gas Explosions in this section for gas explosion information and precautions.

Gas Explosions. Metro personnel should never smoke, drop lighted matches, or use open flames in or around sewers or pumping station substructures. All signs posted in potentially dangerous areas must be obeyed.

Three conditions must be present to cause a gas explosion: a sufficient concentration of gas, sufficient oxygen to support combustion, and a source of heat greater than the ignition temperature of the gas/air mixture. The minimum and maximum concentrations of a gas/air mixture that will explode if ignited are known as the lower and upper explosive limits. The limits are expressed as percent of gas in the air by volume. For example, sludge gas will explode when the methane content is more than 5 percent and less than 15 percent.

Explosive gases generally come from gasoline floating on wet surfaces or from industrial discharges of grease, fats, oils, solvents, carbon bisulfide, carbon tetrachloride, or methyl chloride that float on or mix with wastewater (producing self-generated gases) or combine with methane.

In confined areas, explosive gas mixtures may develop from mixtures of air and methane, natural gas, manufactured fuel gas, or gasoline vapors. Explosive ranges can be detected by using a combustible gas indicator. Explosions can be avoided by providing adequate ventilation to the area with fans or blowers and by keeping open flames away from areas capable of developing explosive mixtures.

Water System

The Seattle city water supply is protected by a reduced-pressure type backflow preventer on the supply line to the station. This prevents contamination of the water source by backpressure or backsiphoning. All Metro facilities, including pumping stations, conform to Seattle-King County Health Department requirements.

Radiological Hazards

The newest hazard to sewage plant operators results from increasing use of radioactive isotopes in hospitals, research labs, and various industries. Sewer service areas must be checked for radioactive materials. If a discharge from a radioactive substance is detected, the contributor of this discharge should be contacted and asked to monitor this type of waste.

Fire Protection

Electricity is the prime cause of industrial fires; smoking is the second most frequent cause. Other causes, in decreasing order of frequency, are: friction, overheated materials, hot surfaces, burner flames, combustion sparks, spontaneous ignition, burning and welding, incendiary actions, mechanical sparks, molten substances, chemical action, static sparks, and lightning. West Point Division buildings are constructed of nonflammable materials and are designed to provide maximum fire protection.

WARNING

CO_2 displaces oxygen, and suffocation could result when using CO_2 fire extinguishers in confined areas. Use self-contained breathing apparatus (Survivair) when fighting fires in such places.

Fire extinguishers are checked for weight and are charged annually, the results are recorded on each extinguisher and on a master roster. Visual checks are made periodically to ensure units are charged to acceptable pressure. All employees are trained in the fundamentals of fire prevention and are familiar with the following fire prevention practices:

a. Follow good housekeeping practices. Maintain a neat and clean work area.

b. Obey NO SMOKING signs. Smoke in authorized areas only.

c. Keep doors, exits, stairs, fire lanes, and fire fighting equipment clear of obstructions.

d. Keep combustible materials away from ignition sources. Place oil, solvent, and paint-soaked rags in covered metal containers.

e. Learn to recognize potential fire hazards, and report to the supervisor any hazard beyond your control to correct.

Fire hydrants are checked annually by the fire department for pressure and are flushed periodically to make sure they work.

First Aid Comments

All division supervisors have first aid training. All employees in the West Point division have minimal training in first aid procedures. The fire department instructs all employees in mouth-to-mouth resuscitation and closed chest cardiac massage. All employees are encouraged to attend first aid courses that are offered periodically, and to have a current first aid card. A first aid kit and current first aid book are provided at each regulator station.

MAINTENANCE PRECAUTIONS

Housekeeping

A high standard of housekeeping is emphasized at Metro as it is the greatest single deterrent to fire, accidents, and disease. Every effort is made to eliminate fire hazards by using proper containers for wastes, papers, and rags, and by emptying the containers frequently. Deposits in cabinets, ductwork, or piping are cleaned out frequently. Immediate cleanup of liquid or chemical spills such as water, oil, or acid will prevent falls, burns, or skin irritations. The chance of infection and disease is reduced if tools are thoroughly cleaned after contact with wastewater or sludge.

Floor drains collect, in traps or at bends, particles, chemical precipitates, road grit, tools, paper, and rags; therefore, these drains and traps are cleaned frequently. Use of wyes or tees with blind flanges helps in unplugging and cleaning. When grease builds up, hot water or steam flushing prevents clogging and reduces hazards.

The following actions must be avoided when housekeeping:

a. Cleaning on or near equipment that is operating. (Normally, equipment must be shut down and locked out when cleaning nearby. Personnel must be extremely cautious when cleaning around operating equipment.)

b. Mixing common cleaning agents that produce a dangerous compound. (Read instructions on containers.)

c. Using hazardous cleaning chemicals without proper protective clothing, equipment, and ventilation.

d. Overreaching.

e. Climbing on rocks, pipes, or equipment.

f. Using compressed air to blow off dust. (The maximum allowable pressure is 30 psi [2.1 kg/sq cm].)

g. Entering hazardous areas, such as manholes, without adequate training, protection, and assistance.

h. Moving or attempting to move, objects that are too heavy or lifting heavy objects incorrectly. (Refer to material handling, manual methods, in the plant or division safety manuals for correct moving and lifting procedures.)

i. Hosing down areas where electrical equipment is located.

j. Using ladders improperly. (Refer to special operating precautions for ladders and stairs in the plant or division safety manuals for correct ladder use.)

Material Handling

The improper handling of materials can be a significant cause of injury to personnel. Poor handling practices can lead to hernias, back strains, crushed toes, lacerations, and other injuries. Ensure that adequate help is available. Use the chain hoist when removing or installing equipment and a handtruck when moving material or equipment. Wear personal protective equipment, such as leather gloves and safety-toe shoes, when necessary. Good housekeeping practices are important when handling materials. Clean up spilled water, grease, or other substances immediately.

The normal maximum load that shall be lifted by one man is 75 pounds (34 kg). Before lifting an object, ensure that the surface is free from oil, grease, or other substances that will make the object slippery. Check the floor to ensure that no slippery substance or obstructions are in the way and that the path is clearly visible. Place feet so that you have a firm footing. Grasp the object securely in case the center of gravity of the object shifts. Lift the object, beginning in a squatting position with the back straight and with the legs exerting most of the lifting force. Lift smoothly and evenly. Avoid twisting the body while lifting. The load should be carried as close to the body as possible and grip should not be shifted. Any lift that requires excessive exertion must not be attempted without assistance.

ADMINISTRATION AND
MAINTENANCE

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SECTION III
ADMINISTRATION AND MAINTENANCE

RECORD KEEPING AND REPORTING

Detailed records form a pumping station operation and maintenance history which serves as a baseline for analysis of station and equipment performance. Their importance cannot be overemphasized. Pumping station records and reports include:

1. Station Logbooks
2. Operator's Work Schedule
3. Sewage By-Passing or Overflow Reports
4. Maintenance Work Orders
5. Machinery History Cards

Logbooks

The station logbook, kept in the control room is a chronological record of all station events (figure 3-1). All persons visiting a station for any reason enter, in ink, their names, time of day, and purpose of visit on the correct daily page. All services, maintenance work, unusual conditions, and equipment malfunctions are also recorded.

Operator's Work Schedule (Checklist)

The operator's work schedule, or checklist, defines the daily checks and services performed by the station operator during any given week. The schedule includes preventive maintenance tasks, such as filter changes and some lubrication, as well as regular operational responsibilities. Although performed by operations personnel, the scheduling of preventive maintenance tasks is done by the respective divison maintenance department. When completed, the daily check sheets become a weekly record of work done. These forms are filed at the Duwamish Pumping Station.

Sewage By-Passing or Overflow Report

Sewage by-passing or overflow is normally discovered by the operations crew responding to a pumping station alarm or to a concerned citizen's report. Operations personnel on the scene will immediately evaluate the situation and report to the Operations Supervisor on duty at the WPTP. He will dispatch repair crews and immediately inform:

- CATAD central console operator (during normal working hours) or
- West Point treatment plant operator (after hours) and
- All other persons listed in the current edition of the Metro Overflow Manual (see note below).

All events are recorded in logbooks, daily reports, and diaries. Finally, the Operations Supervisor prepares a Sewage By-passing or Overflow Report, OP-40 (figure 3-2), and distributes copies as directed in the Metro Overflow Manual.

Note

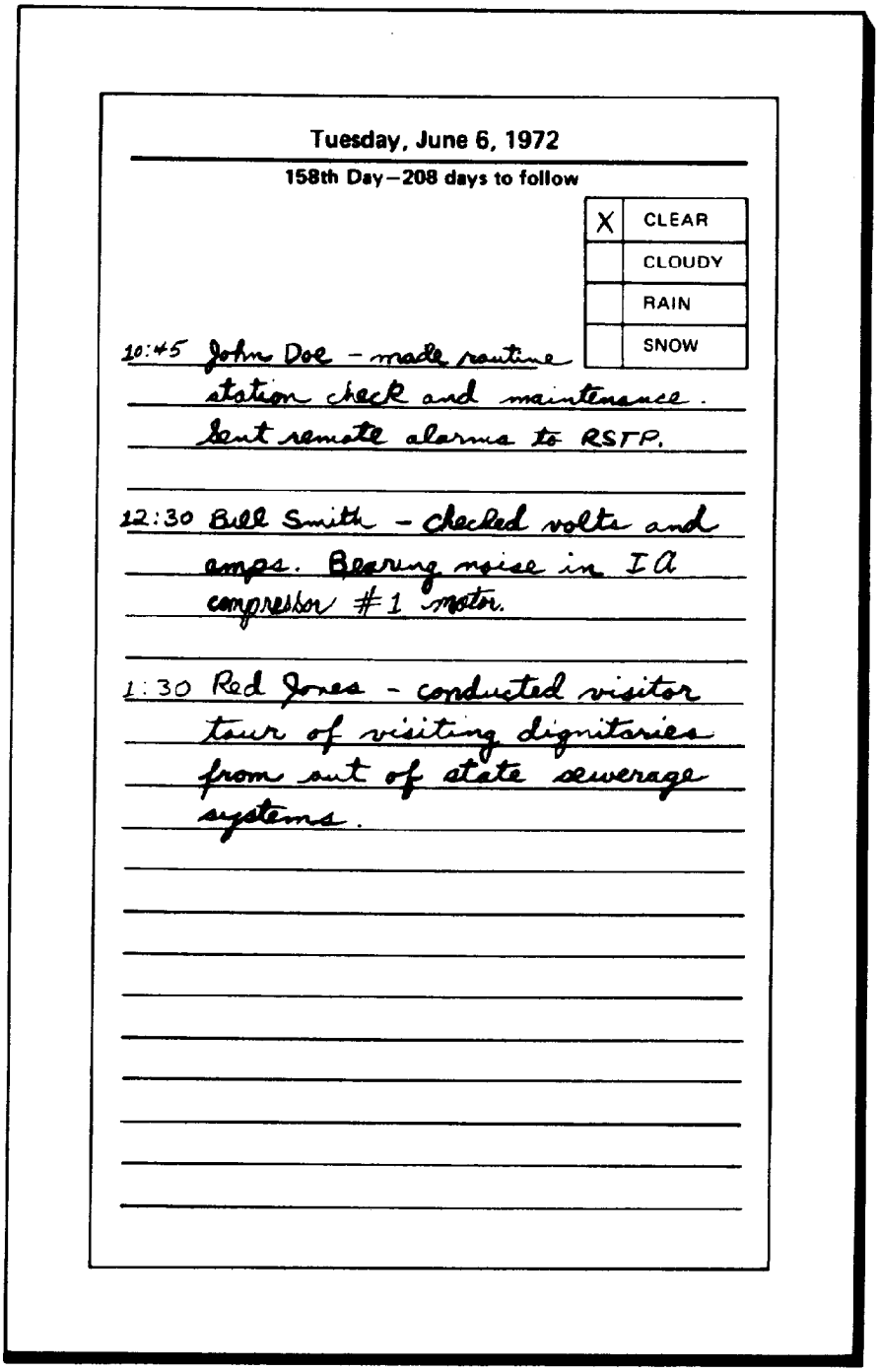
The Metro Overflow (Emergency Procedures Involving Bypassing or Overflowing of Sewage) Manual is issued annually and contains current, detailed bypass/overflow procedures and instructions.

Maintenance Work Order

The Maintenance Work Order (MWO) (figure 3-3) is used for all maintenance work at the pumping station. The Operations Supervisor is responsible for initiating the MWO, which, except for emergencies, must be approved by the Division Superintendent. Normally the Operations Supervisor fills out the MWO and forwards copies 1 and 2 to the Assistant Superintendent-Maintenance, retaining copy 3 for followup. When work is completed, Maintenance returns copy 2 to Operations for filing. In emergencies, the Operations Supervisor or senior operator calls either the Assistant Superintendent-Maintenance or applicable craft supervisor, supplying all pertinent information. Maintenance writes the MWO and forwards copy 3 to the requestor. Copy 2 is returend to Operations when the work is completed. Figure 3-4 illustrates Maintenance Work Order flow. Refer to the West Point Sludge Dewatering Facilities O and M manual for further information.

Machinery History Cards

The machinery history card (figure 3-5) is the major equipment maintenance record. On the cards are recorded both scheduled preventive maintenance operations and those performed in response to MWOs. Machinery history cards (light green for mechanical equipment and yellow for electrical equipment) identify the machinery, manufacturer, model, and important physical data for each equipment item in the pumping station. On each card a progressive service record tells what has been done to the item (including the product used for lubrication and the specific parts



Tuesday, June 6, 1972

158th Day—208 days to follow

X	CLEAR
	CLOUDY
	RAIN
	SNOW

10:45 John Doe - made routine station check and maintenance. Sent remote alarms to RSTP.

12:30 Bill Smith - checked volts and amps. Bearing noise in IA compressor #1 motor.

1:30 Red Jones - conducted visitor tour of visiting dignitaries from out of state sewerage systems.

Figure 3-1. Typical Pumping Station Logbook Page

Item #

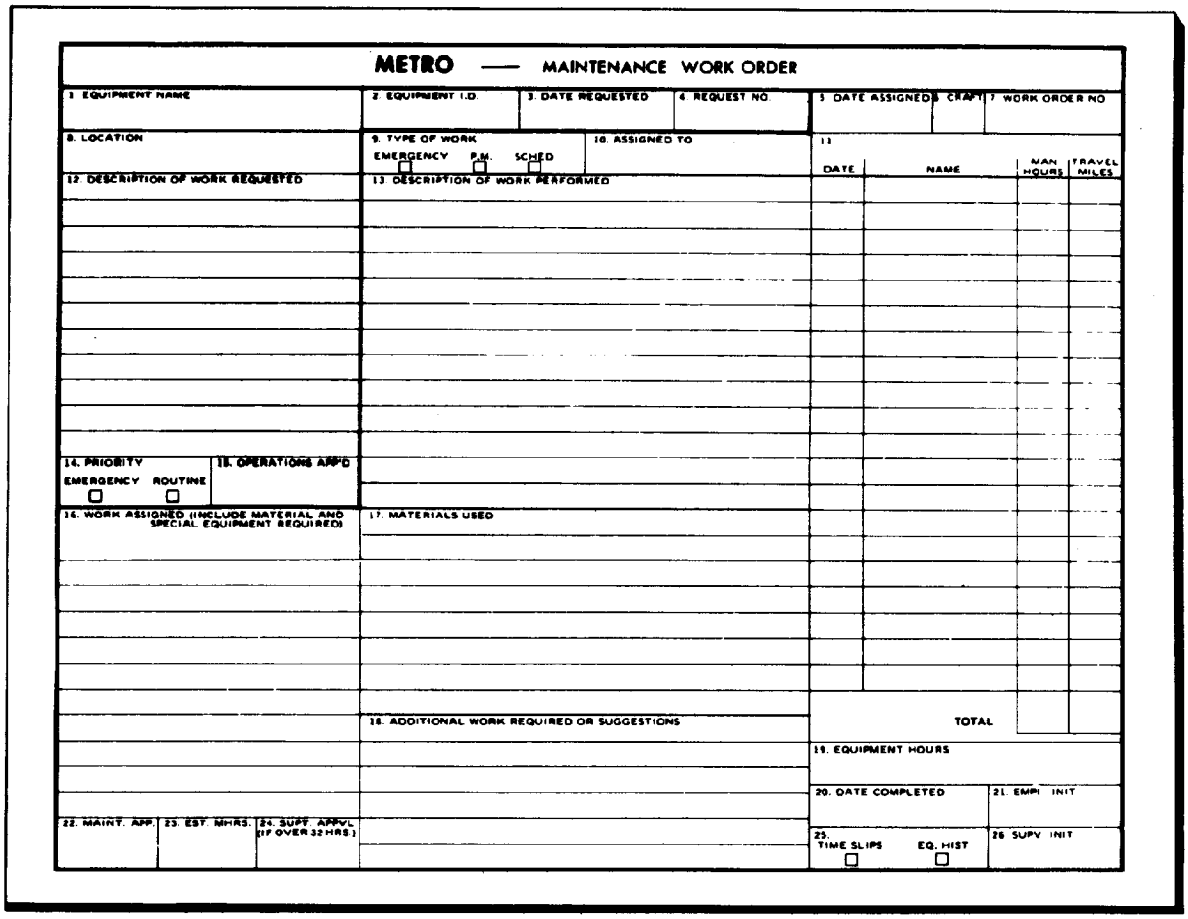
SEWAGE BY-PASSING OR OVERFLOW REPORT *

1. Division Involved _____ Nature of Overflow:
2. Facility Affected _____
3. Location _____ 6. Scheduled _____
4. Date _____ 7. Emergency _____
5. Time _____ PDT _____ PST _____
8. Tributary to (receiving water affected) _____
9. Cause of Overflow or Bypass _____
10. Quantity By-Passed _____
11. Remedial Measures (emergency generators, septic tank pumpers, equipment repair, etc.)
12. Reported by _____ Reported to _____ (key person)
13. Crew Dispatched (names) _____
14. Persons Called in Regulatory Agencies. Date Time of Call
15. Remarks: _____

OP-40

*When reporting by radio, use item numbers of each line rather than descriptive title.

Figure 3-2. Sewage By-Passing or Overflow Report



METRO — MAINTENANCE WORK ORDER

1. EQUIPMENT NAME	2. EQUIPMENT I.D.	3. DATE REQUESTED	4. REQUEST NO.	5. DATE ASSIGNED	6. CRAFT	7. WORK ORDER NO
8. LOCATION	9. TYPE OF WORK: EMERGENCY ☐ P.M. ☐ SCHED ☐	10. ASSIGNED TO				

12. DESCRIPTION OF WORK REQUESTED	13. DESCRIPTION OF WORK PERFORMED

11. DATE	NAME	MAN HOURS	TRAVEL MILES
	TOTAL		

14. PRIORITY: EMERGENCY ☐ ROUTINE ☐	15. OPERATIONS APP'D

16. WORK ASSIGNED (INCLUDE MATERIAL AND SPECIAL EQUIPMENT REQUIRED)	17. MATERIALS USED

18. ADDITIONAL WORK REQUIRED OR SUGGESTIONS	19. EQUIPMENT HOURS
	20. DATE COMPLETED / 21. EMPL INIT
	25. TIME SLIPS ☐ EQ. HIST ☐ / 26. SUPV INIT

22. MAINT. APP.	23. EST. MHRS.	24. SUPT. APPVL (IF OVER 32 HRS.)

Figure 3-3. Maintenance Work Order

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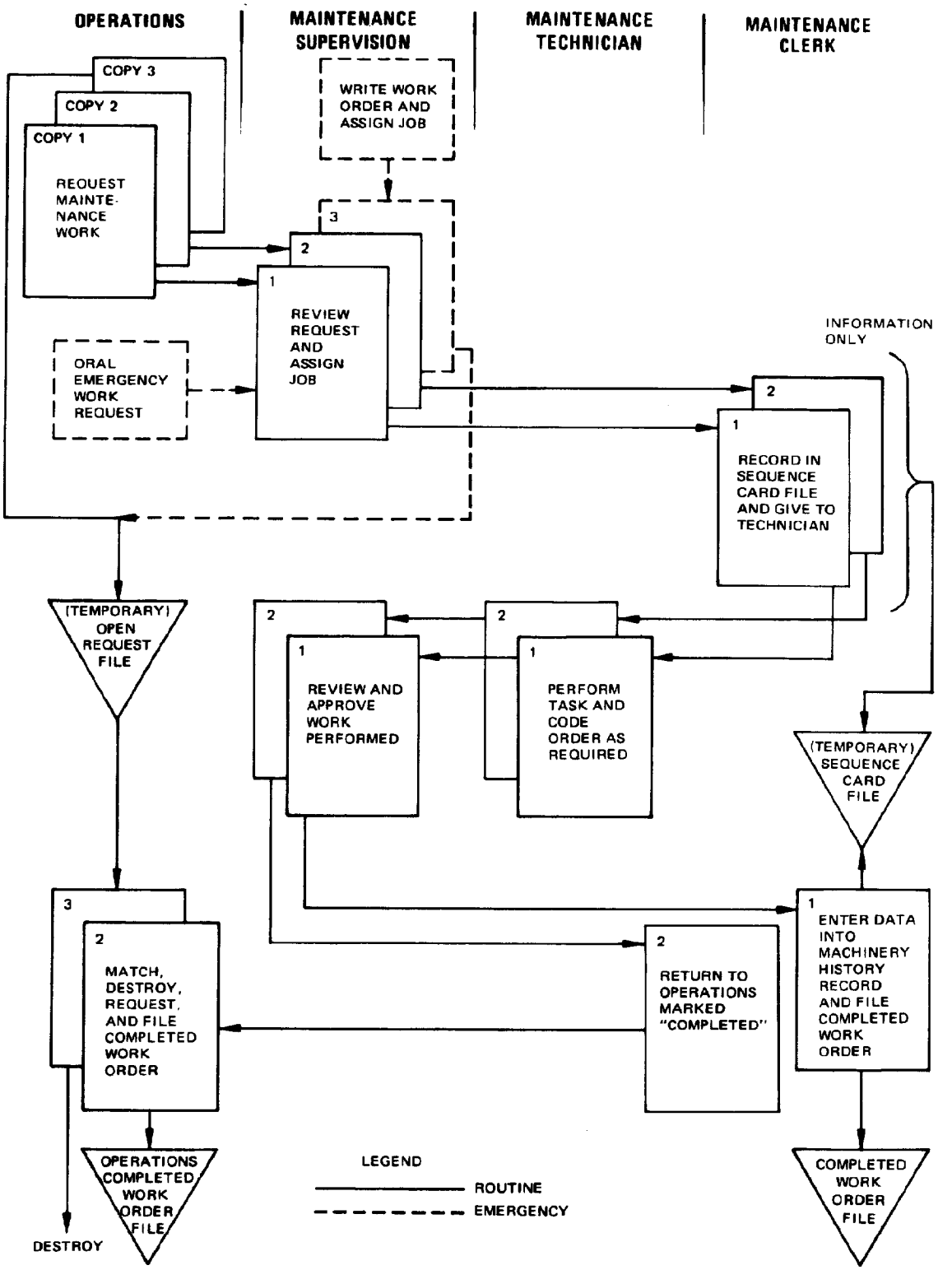

Figure 3-4. Maintenance Work Order Flow

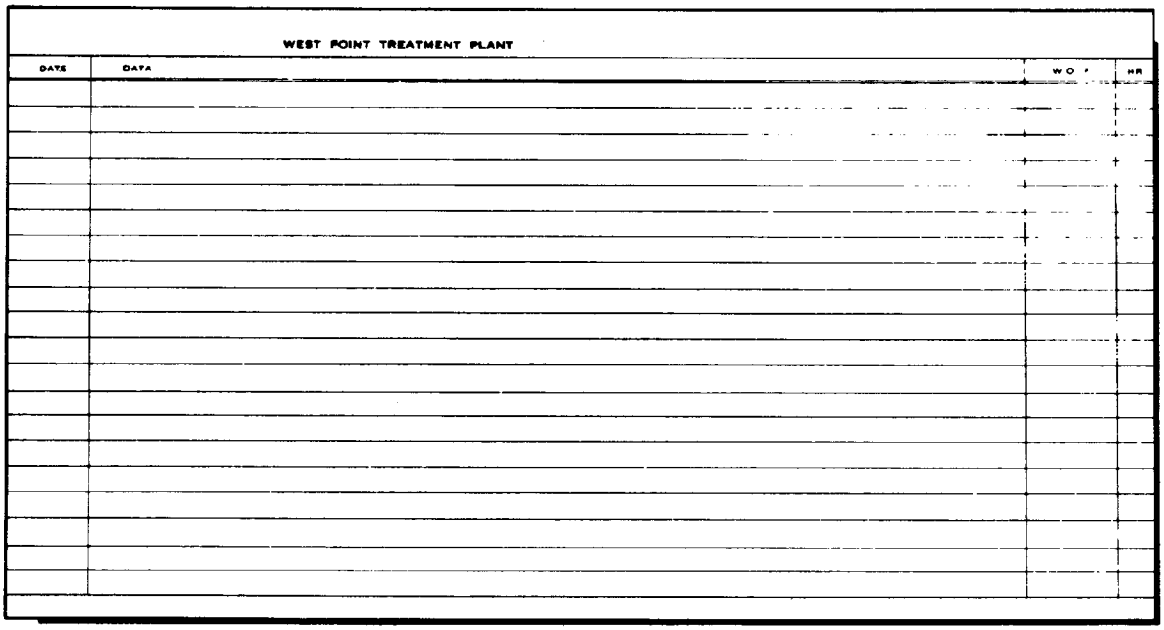

Figure 3-5. Machinery History Card (Typical)

affected by a service operation), the date, the person who performed the service, and, when applicable, the MWO number requesting the work and the time required to complete it. The machinery history cards for the station are filed at the WPTP Maintenance Office.

Equipment Data Sources

Station specifications and engineering drawings, including "as built" drawings and records (showing deviations from the original design) are filed at the Metro Engineering Services Office, 821 Second Avenue, Seattle, Washington 98104. Equipment manuals and manufacturer's publications are located in the office of the respective area supervisor, in the WPTP maintenance office, and if practicable, in the station.

MAINTENANCE

The following paragraphs contain information on scheduled preventive maintenance and unscheduled corrective maintenance for station equipment, periodic station maintenance and housekeeping tasks, equipment data sources, and maintenance records and reports. The Maintenance Section performs certain maintenance tasks and the Operations Section others, although Maintenance is responsible for overall scheduling and coordination.

The preventive maintenance schedule specifies the procedures and time intervals for inspection, testing, mandatory parts replacement, cleaning, lubrication, adjustment, and calibration of equipment. Corrective maintenance required because of equipment malfunction or damage is performed in response to a maintenance work order initiated by Operations. Normally only specialists and technicians in the Maintenance Section will perform maintenance work under these two plans, although, with the concurrence of the Maintenance Section, the station operator may perform minor services or temporary equipment repairs.

Scheduled preventive maintenance extends the service life of equipment and prevents breakdown that could disrupt pumping station operation. The schedule covers mechanical and electrical checks and services, instrument testing and servicing, and equipment lubrication.

Station maintenance crews log all checks and services performed and the condition of the equipment and operations on machinery history cards and/or the station logbook. These records keep the Maintenance Supervisor informed at all times of staiton equipment status and establish a basis for directing the maintenance work.

Mechanical

Vibration analysis of pumps and motors reveals early signs of possible component failure. Portable vibration monitors can be used to check station equipment. Records of periodic checks are compared with previous records to detect developing faults and prevent failure.

Annual examination and testing of the C1 water system backflow preventer is mandatory. A report of the yearly test result goes to the Seattle-King County Health Department. This report includes a report of any repairs to the backflow preventer that may have occurred during the year.

Electrical

Motor starter contactors and low-voltage switch gear are checked and cleaned yearly by maintenance electricians.

Instrumentation

Preventive maintenance includes periodic cleaning, inspection, and recalibrating instruments and checking instrument loops.

Lubrication

Correct lubrication is essential to proper maintenance of machinery. Table 3-1 lists by system the parts requiring lubrication, the time interval between lubrications, the recommended lubricant, and the equivalent Standard Oil Company product.

Periodic Station Maintenance and Housekeeping

The Operations Department is responsible for many routine equipment checks and services that are a part of the preventive maintenance program. The station operators are also responsible for housekeeping, as well as building and grounds maintenance.

Equipment Maintenance. Station operators perform many routine duties, some of which are related to preventive maintenance. These include certain inspections, adjustments, lubrication tasks, etc. The operator services tables in this manual, covering the various station systems, detail some of these requirements. Others are listed in the two-page "daily check sheet" form that covers a week's routine duties and is filled out by the operator as the work is completed. This check list specifies the particular tasks and the days they are scheduled. In addition, card files at the South area supervisor's office list duties routinely performed by station operators. Each morning the operator on duty consults this file as he plans his daily program.

Grounds and Building Maintenance. Pumping station operators are responsible for routine maintenance of the buildings, lawns, shrubs, plants, and landscaped areas. Cleanliness, good lighting, and safe working conditions enhance efficient station operation, and attractiveness of the grounds is important to good community relations. Plant maintenance and housekeeping tasks are listed below.

Weekly Checks and Services:

1. Check condition of lawn, shrubs, and trees, particularly during the growing season. Mow grass, weed, trim, fertilize, and water as necessary. Check tree supports.

2. Clean driveway.

3. Check all light fixtures. Replace defective bulbs and flourescent tubes.

4. Clean all floors, stairways, and equipment platforms. Check equipment panels and components for dust and smudges; clean if necessary.

Quarterly Checks and Services:

1. Check outdoor drains and remove debris.

2. Check roof, roof drains, vent, and vent screen. Check that drain inside vent is free and that no water has collected at base of vent.

3. Check outside paint for chipping, peeling, and blistering. Repair damaged areas.

Continuing Checks and Services as Needed:

1. Check paint on interior walls; repair as necessary.

2. Check lower-level walls for seepage and clean as necessary. If seepage is excessive, notify supervisor.

3. Check condition of driveway structure; if damaged, notify supervisor.

Table 3-1. Lubrication Schedule

EQUIPMENT	TIME INTERVAL	PREFERRED LUBRICANT	STANDARD OIL CO. EQUIVALENT
INFLUENT GATE SYSTEM:			
Sluice gate seating faces, wedge surfaces, and stem threads.	As required or yearly.	Water-resistant grease-Texaco Multi-Fas HD No. 2, Shell Alvania No. 7, or Lubriplate No. 630 AAA.	Chevron Dura-lith Grease EP 1.
RAW SEWAGE PUMPING SYSTEM:			
Radial and thrust bearings.	4 mo.	Standard Oil Rykon, red color, Trade Grade No. 3.	Chevron Industrial Grease, Heavy.
Journal crosses (normal operation).	500 hr.	SAE 140 mineral oil.	Chevron gear oil 140.
Journal crosses (extreme duty).	200 hr.	SAE 250 mineral oil-Texaco RASR-629, Gulf No. 180, or Socony Gargoyle Viscolite SS.	Chevron gear oil 250.
Sliding splines.	500 hr.	Long fiber grease-Texaco Marfax No. 1 EP or No. 0 EP. Mobil Grease SP No. 53-030, or Texaco ALL Temperature No. 1992.	Chevron Dura-lith Grease EP 1.
Motor bearings.	6 mo.	GE Long Life Grease No. D6A2C5.	Chevron BRB Grease No. 2.
SUMP DRAINAGE SUBSYSTEM:			
Sump pump thrust and shaft bearings.	3 mo.	ESSO Andok C, Texaco No. 1994, Regal Starfex Special, Socony Vacuum Arco General Purpose, Shell Alvania No. 2, or Sinclair Ahamrock Lub F.	Chevron Dura-lith Grease 2.
Sump pump sleeve guides.	3 mo.	Sinclair Ind. Lithaline No. 1, Sinclair Semi-fluid Grease, or Shell Alvania EP 5214.	Chevron Dura-lith Grease 0.
Sump pump motor bearings.	3 mo.	Chevron BRB Grease 2.	Chevron BRB Grease No. 2.

Table 3-1. Lubrication Schedule (Cont.)

EQUIPMENT	TIME INTERVAL	PREFERRED LUBRICANT	STANDARD OIL CO. EQUIVALENT
HEATING AND VENTILATION SYSTEM:			
Intake, Transfer, Exhaust, and Entry fan bearings.	2 yr.	Sinclair Litholene, ESSO Andok C, or Shell Alvania No. 2.	Chevron BRB Grease No. 2.
Intake, Transfer, Exhaust, and Entry motor bearings.	6 mo.	SAE 20 nondetergent oil.	Chevron OC Turbine Oil 15.
C1 AND C2 WATER SYSTEMS:			
C2 water pump motor bearings.	4 mo.	Chevron BRB NO. 2 lithium base bearing grease, NLGI Grade 2.	Chevron BRB Grease No. 2.

STATION CONTROL AND
ALARM SYSTEM

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SECTION IV
STATION CONTROL AND ALARM SYSTEMS

INTRODUCTION

The facility is normally unattended and operates automatically with the raw sewage pumping system controlled from the CATAD central console, and all other systems, except the heating and ventilation system, monitored there. Station systems can also be controlled and/or monitored from panels in the control room. There are two station control panels, the main control panel (MCP) and the CATAD telemetry control unit (TCU).

The alarm system warns WPTP and CATAD of station malfunction and provides local visual indication of specific system failures or malfunctions. The system includes the explosive gas hazard alarm, which is an independent subsystem.

STATION CONTROL SYSTEM

Main Control Panel

The main control panel (figure 4-1) is at the southwest wall of the control room between the motor control center (MCC) and the TCU. Inside the panel (see figure 7-1) are raw sewage pumping system control and alarm relays, the wet well level transmitter, instrumentation interface devices, instrument air system pressure regulators and distribution manifold, and alarm (control power) panelboard B. Many of the components, particularly those related to pump speed and wet well level, are electrically connected to switches, selectors, and indicators on the face of the panel. Also on the face of the panel are the alarm annunciator and explosive gas level monitor. Functioning of the alarm annunciator and explosive gas level monitor is covered in this section (see Alarm System); functioning of other MCP components is described in the related system section.

Telemetry Control Unit (TCU)

The telemetry control unit is the station CATAD terminal and computer interface. The unit, a Northwest Digital Systems (NDS) model 808, contains a communications modem, a test panel, an ac to dc power supply with batteries for emergency operation, a relay panel and seven circuit cards for memory, operations control, analog-to-digital conversion, time synchronization, and data collection transmission. The NDS TCU, unlike its Philco-Ford counterpart, is computer based and easily reprogrammed to alter its operational programs. Below the TCU, behind the double access doors, is a relay and instrument subpanel containing the interface equipment and a power receptacle box, 120-Vac trouble light receptacle, 120-Vac instrument power plug strip, and a 24-Vdc power supply. On the end of the MCP are three-wire termination and analog output resistor mounting terminal blocks. The unit connects to the telemetry network of duplex telephone lines for high-speed transmission of data between the computer and the remote terminals. Each TCU recognizes and responds to its unique address code among the signals received from the computer.

The TCU collects station data, such as pump speeds, wet well level, setpoints, and total flow and converts them to digital signals for transmittal to the CATAD central computer. It also accepts commands from the computer to the station (figure 4-2). The contact status and pulse counter indicators on the front panel light up when the LAMPS pushbutton is pressed. They indicate that command and/or status information is being exchanged between the station and the computer. Normally the station is unattended and operation is totally automatic. The station sensors are analog devices that develop information in the form of varying voltages or contact positions about water levels or equipment status. The TCU converts this analog data to digital form, encodes it, and stores the information until polled by the computer. The computer converts the input data into signals for output to a visual display monitor and a teleprinter, and as required, sends back commands through the TCU to station equipment. Commands include starting or stopping pump motors, regulating pump speed, and changing setpoints.

If normal line voltage fails, the emergency batteries automatically supply power to the TCU power supply for up to 8 hours at maximum load. When not in use, the batteries are kept charged through the power supply battery charging circuit.

Station CATAD Control

The Computer Augmented Treatment And Disposal (CATAD) system permits automatic, supervisory, or local control of station wet well level and raw sewage pump speed. See CATAD System O & M Manual TSD-1 for more information.

CATAD Automatic Control. In automatic mode (figure 4-3), after analyzing the input data, the computer sends back operating instructions through the telemetry system and TCU to the RSP system controls. Control operations include changing pump speeds and wet well level setpoints.

CATAD Supervisory Control. At his discretion, the CATAD operator (figure 4-3) can change the station CATAD

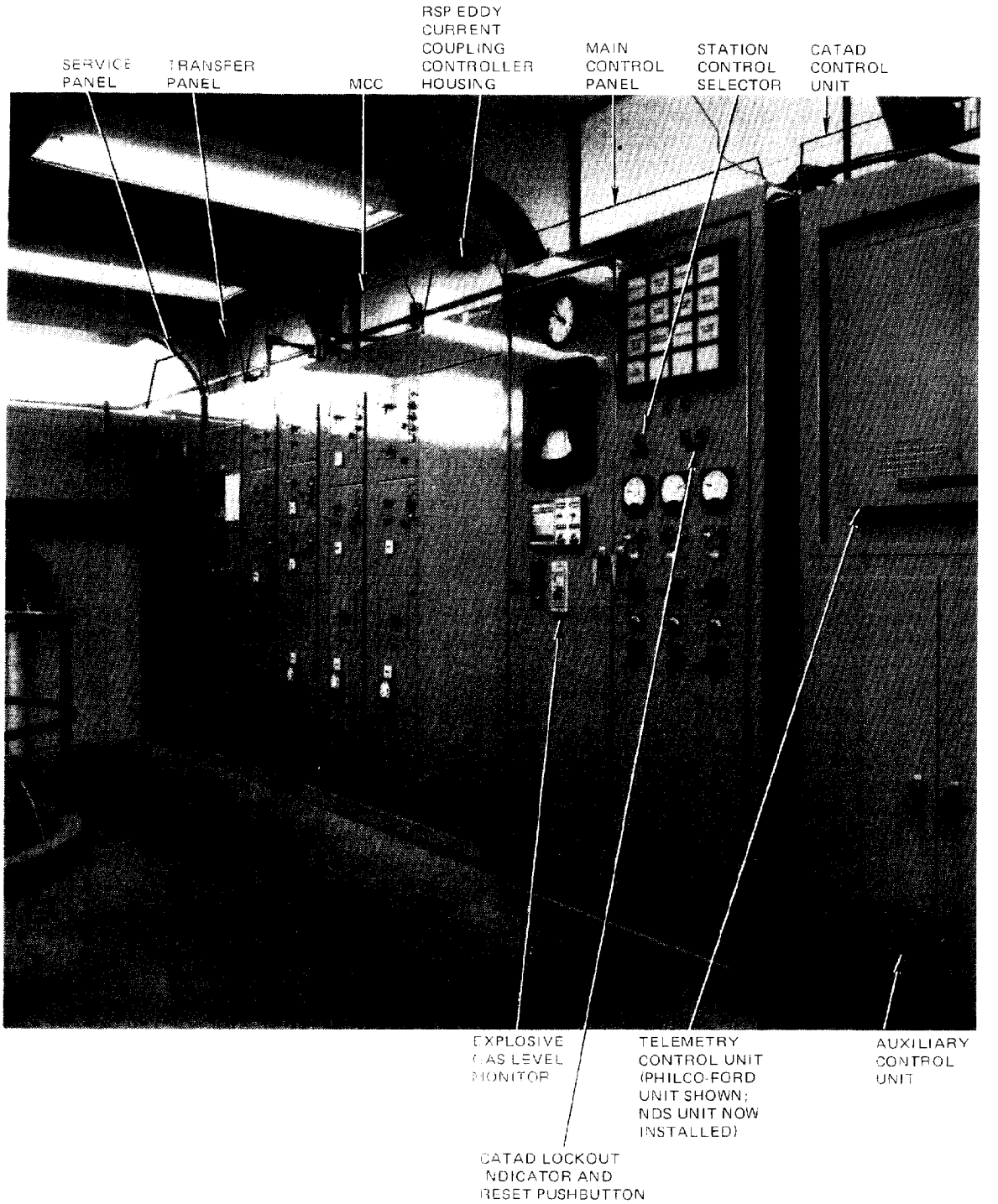

Figure 4-1. Station Control Panels

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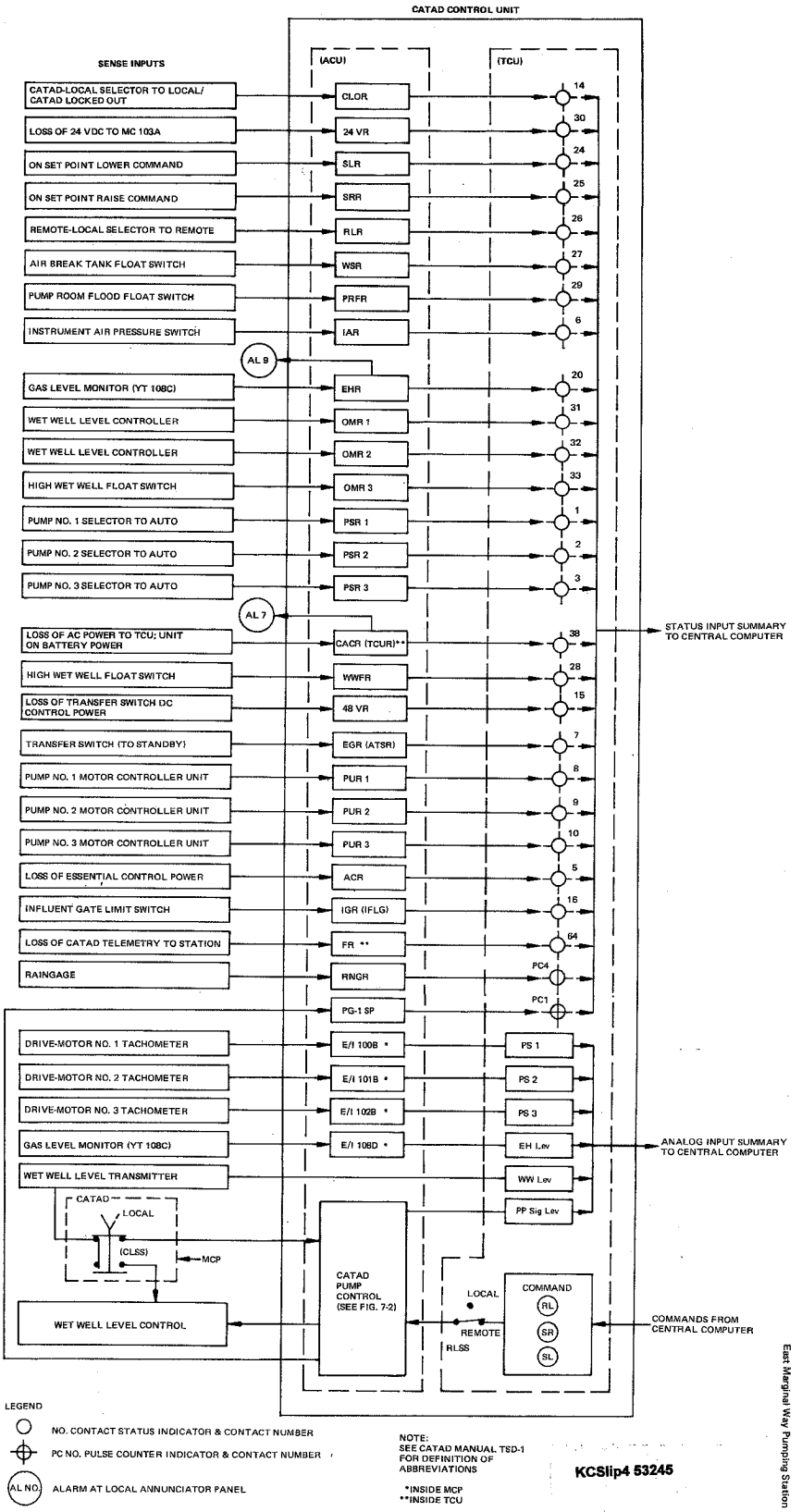


Figure 4-2. Station CATAD Control Block Diagram

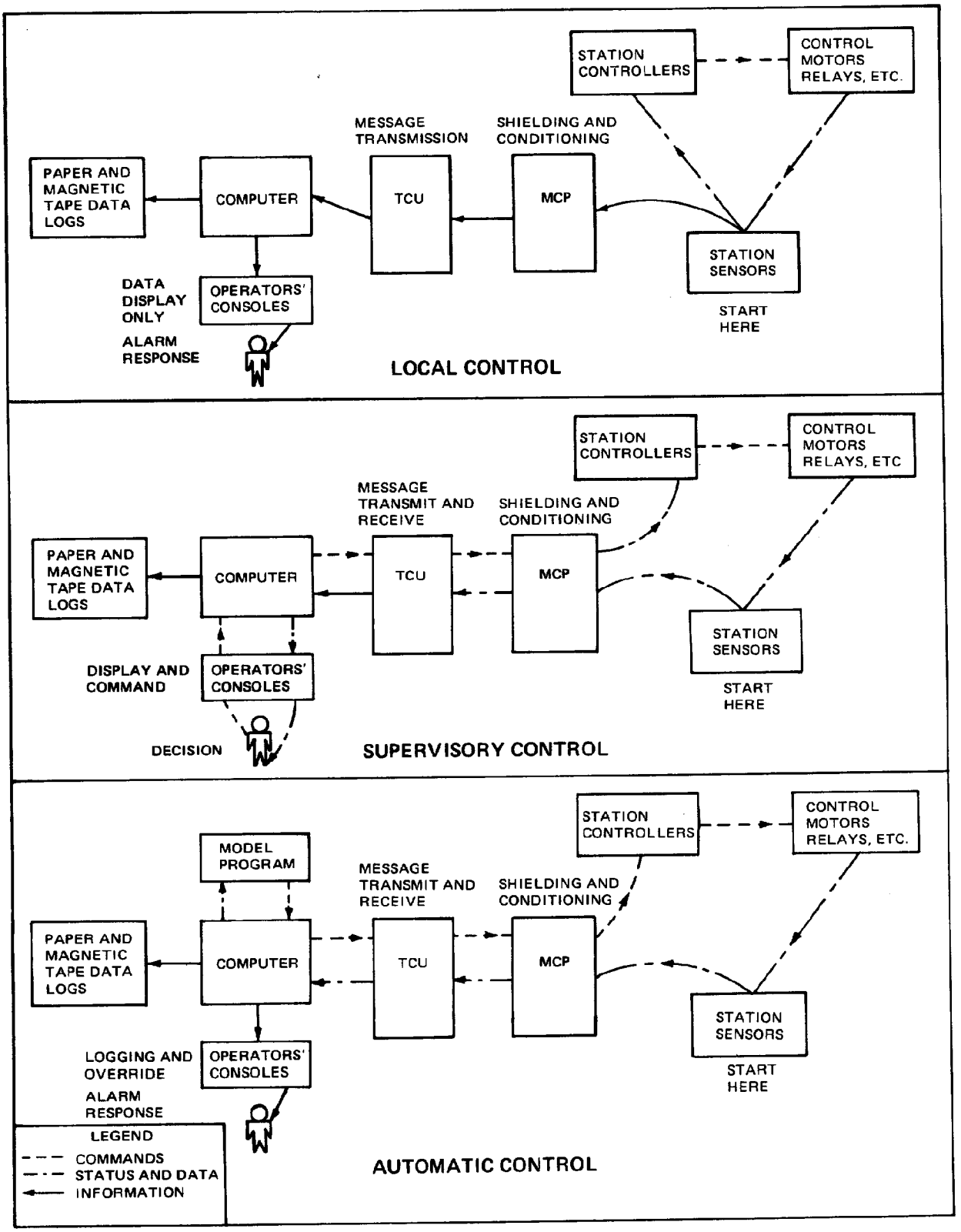


Figure 4-3. Station CATAD Control Modes

operating mode to supervisory or local. In supervisory mode, the operator can change pump speeds and wet well level setpoints from switches on the central console. Supervisory control is often used during storms, since the operator can anticipate regulatory requirements.

CATAD Local Control. In the CATAD local mode (figure 4-3), the CATAD command relays drop out and the wet well level setpoint cannot be raised or lowered from the CATAD central console, but only from the MCP. All monitoring capabilities remain. This mode can be selected from the CATAD central console, or at the station by placing the TCU CONTROL selector to LOCAL. If the latter method is used, an informational signal is transmitted to the CATAD central console through TCU contact 64 because station CATAD control cannot be regained until the TCU CONTROL selector is replaced to REMOTE.

Station Local Control

Wet well level and raw sewage pump speeds may be regulated manually or automatically strictly through the local station control networks. Station local control is selected at the MCP by placing the station CONTROL SELECTOR (normally to CATAD) to LOCAL. This action also triggers "CATAD lockout" alarms at the CATAD central console, and lights the CATAD LOCKOUT indicator on the MCP which remains on as long as the station CONTROL SELECTOR is in LOCAL. Only CATAD monitoring status capabilities are retained. To return to CATAD operational control, the station CONTROL SELECTOR is placed to CATAD, and the CATAD LOCKOUT RESET pushbutton pressed to reset alarm circuits and relays and to extinguish the CATAD LOCKOUT indicator. Lockout of CATAD control, with all accompanying alarms and indications, is also triggered by high or low wet well level or by failure of pulse generator APG-1 (which drives the wet well level setpoint stepping motor). See section V for a complete description of wet well level and RSP system control, operation, and alarms.

Alarm Indications

Station control system alarms (table 4-1) are triggered at the MCP annunciator, CATAD central console, and/or the WPTP outlying facilities alarm annunciator panel via Metrotel. The CATAD operator or treatment plant shift supervisor initiates action to dispatch a crew to the station.

Operator Services

The TCU is maintained by a commercial computer service organization that is responsible for all adjustment, testing, maintenance, and repair. The pump crew that periodically checks the station is responsible only for the services described in table 4-2.

Operating Procedures

The heart of station operation (table 4-3) is the RSP system (section VII). Therefore, station operating procedures relate primarily to that system which is the only one controlled through the MCP and TCU.

The TCU is part of the Metro CATAD system which links remote facilities to the CATAD central computer. The TCU is normally maintained only by qualified CATAD operators, instrument technicians, or engineering personnel. Occasionally, however, station operators may be required to start up or shut down the unit (table 4-4).

Table 4-1. Control System Alarm Indications

ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
			Note *Record all actions in station log.*
CATAD POWER FAILURE (AL 7)	CATAD ac power relay TCUR (TCU status indicator 38)	Loss of ac power to TCU (TCU switches to standby battery power).	Check that circuit breaker 5 in alarm (control power) PANELBOARD B is ON. If breaker is OFF, check station log to determine reason; then place to ON. If breaker trips, place to OFF and notify supervisor. To clear annunciator, press alarm RESET pushbutton. If ac power to TCU is to be disrupted for an extended period, shut down TCU completely (table 4-4) and place CONTROL SELECTOR on MCP to LOCAL to allow station to operate under local automatic control.

Table 4-1. Control System Alarm Indications (Cont.)

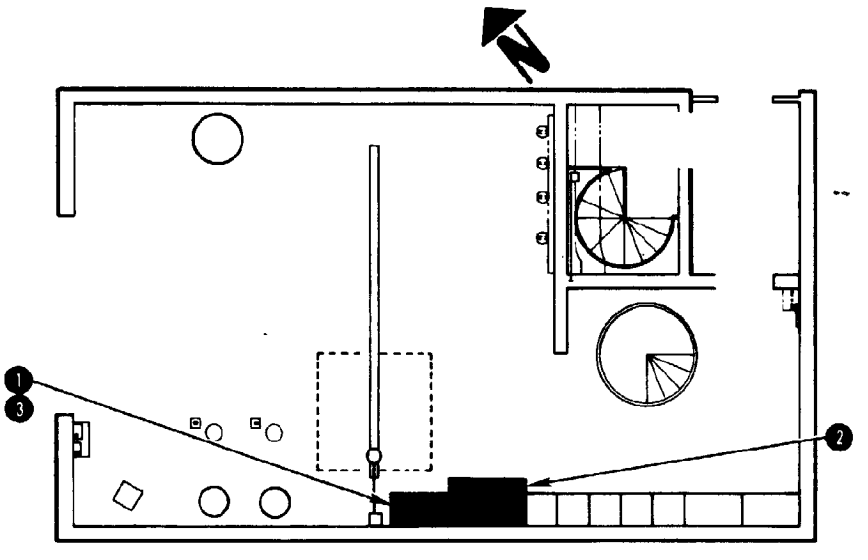
ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
MCP Power Failure	AC power relay (ACR) in auxiliary control unit (TCU status indicator 5)	Loss of ac power to MCP.	Check that circuit breaker 1 in alarm (control power) PANELBOARD B is ON. If breaker is OFF, check station log to determine reason; if permissible, place to ON. If breaker trips, place to OFF and notify supervisor. **Note** *CATAD POWER FAILURE and MCP power failure can also be caused by station power outage or open circuit breakers 2 and 4 in alarm PANELBOARD B. If station power has failed, refer to section V (Electrical Power System) and Appendix D (Emergency Information), table D-2 for corrective action. Circuit breakers 2 and 4 are main disconnect switches for alarm (control power) PANELBOARD B.*
CATAD Lockout	Wet well level transmitter via CATAD lockout pressure switch PS 125 or PS 126	High wet well level (PS 126) – elevation 98.2. Low wet well level (PS 125) – elevation 94.0.	Raw sewage pumping system should be operating under wet well level control. CATAD LOCKOUT indicator should be on. If so monitor RSP system until situation is corrected; then press CATAD LOCKOUT RESET pushbutton to return station to CATAD control. If RSP system has not switched to local control, do so manually by placing station CONTROL SELECTOR to LOCAL. If RSP system does not operate correctly or cannot maintain headway, switch to HAND mode (table 7-7) and manually operate pumps to return to setpoint. Place TCU control selector to LOCAL (optional if malfunction or aberrant wet well level condition will last long). When situation is corrected, return RSP system to AUTOmatic mode (table 7-7); return station to CATAD control by placing station CONTROL SELECTOR to CATAD and pressing CATAD LOCKOUT RESET pushbutton and placing TCU CONTROL selector to REMOTE, as required.
	CATAD lockout relay in MCP (TCU status indicator 14)	Failure of pulse generator APG-1.	Ensure that RSP system is under wet well level control. Notify supervisor that instrument technician is required. **Note** *No audible click near TCU for more than 20 seconds indicates possible pulse generator malfunction.*
CATAD telemetry failure (to station)	Telemetry monitoring relay FR in TCU (TCU status indicator 64)	Loss of CATAD telemetry signal to station (station automatically reverts to local control).	Ensure that RSP system is under wet well level control and notify supervisor or CATAD central console operator. Place TCU CONTROL selector to LOCAL.

Table 4-2. Station Control System Operator Services

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY			**Note** *Record all actions in station log.*
1. At Telemetry Control Unit (TCU):			
1a. Verify that TCU CONTROL selector is to REMOTE.	1a. Selector to REMOTE.	1a. Selector to LOCAL.	1a. Check station log and with supervisor for possible reason. If permissible, place to REMOTE.
1b. Check status indicator lamps.	1b. All status indicators off.	1b. Status indicator 5 or 64 on.	1b. Refer to table 4-1.
1c. Press LAMPS pushbutton.	1c. Contact status indicators 1, 2, and 3 come on. Pulse counter No. 1 status indicator comes on. Status indicators 8, 9, 10, 31, 32, and 33 may come on singly or together, depending on RSP status.	1c. One or more of required status indicators does not come on.	1c. Check that RSP mode selectors are all to AUTO. If not, determine reason. If none can be found, place RSP mode selectors to AUTO. If selectors are correct and status indicators 1, 2, and 3 do not light, report condition to CATAD central console. If pulse counter No. 1 status indicator does not light, CATAD lockout should be in effect (see table 4-1). If not, contact CATAD central console.
2. At MCP, verify that station CONTROL SELECTOR is placed to CATAD.	2. Selector to CATAD.	2. Selector to LOCAL.	2. CATAD lockout is in effect. Check station log and with supervisor for verification. If permissible, place selector to REMOTE and press CATAD LOCKOUT RESET pushbutton to return station to CATAD control. If CATAD lockout is verified, ensure that RSP system is functioning properly under station local control.

Table 4-2. Station Control System Operator Services (Cont.)

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
MONTHLY			
3. At TCU:			
3a. Pull power plug from ac receptacle; or at alarm (control power) PANELBOARD B inside MCP, place circuit breaker 5 to OPEN.	3a. TCU switches to internal dc power supply. TCU status indicator 38 comes on when LAMPS pushbutton is pressed.	3a. TCU does not switch to internal dc power supply or dc voltage is insufficient to operate unit. Status indicator 38 does not come on.	3a. Restore ac power and notify supervisor.
3b. Allow TCU to operate on internal dc power supply for 4 hours.	– – –	– – –	– – –
3c. Restore ac power.	3c. TCU switches back to ac power source. TCU status indicator 38 does not come on when LAMPS pushbutton is pressed.	3c. TCU does not switch back to ac power source.	3c. Notify supervisor.



CONTROL ROOM

Table 4-3. Station Operation

PROCEDURES

Note

Prestart and startup procedures assume total station shutdown and isolation which is an extreme situation. Deletion of certain steps by the operator in bringing the station on-line is, depending on circumstances, anticipated, expected, and normal.

Pre-Startup

1. In effluent junction structure, remove slide gates, if installed (table 6-6).

2. Remove pump inlet channel slide gates if installed (table 6-5).

3. On TRANSFER PANEL, place (or verify) TRANSFER SWITCH to NORMAL.

4. At electrical service panel, open (or verify) MAIN circuit BREAKER. Remove padlock and/or lockout tag, as applicable.

5. At MCC, place (or verify) all circuit breakers to OFF. Remove padlocks and/or lockout tags, as applicable.

6. Throughout the station, as applicable, unlatch STOP pushbuttons, place (or verify) ON/OFF switches to OFF, and remove lockout tags from local control stations.

7. At PANELBOARDS A, B, and C, place (or verify) all circuit breakers to ON.

8. Ensure that raw sewage pumping and all support systems are ready to operate. Refer to appropriate system section for prestart and other operator services, (see Table of Contents). The air and water systems are particularly important support systems.

9. At MCP, place station CONTROL SELECTOR to LOCAL.

Startup

1. At electrical service panel, close (place to ON) MAIN circuit BREAKER and check each phase of utility voltage at RELAY METER compartment. Each phase should read 460 volts.

2. At MCC, close (place to ON) all placarded circuit breakers.

3. At MCP alarm annunciator, TEST lamps and press alarm RESET pushbutton.

4. Start up 24 Vdc battery charger (table 5-8).

5. Start up instrument air system (table 8-4).

6. Start up service air system (table 8-8).

7. Start up C2 water system (tables 10-4 and 10-6).

8. Purge wet well bubblers and adjust air flow (table 7-3).

9. At MCP and MCC, set RSP system controls for automatic operation (tables 7-4 and 7-5).

10. Slowly open influent sluice gate (table 6-3).

Note

Influent gate is opened slowly to match influent flow with RSP system and prevent wet well flooding. Depending on weather conditions and how long gate has been closed, this may take 1-1/2 to 3 hours.

11. Monitor rising wet well level at WET WELL LEVEL controller-transmitter LIC 103K on MCP. When wet well level rises past elevation 94.9 (depth in influent channel of 2.4 feet or 0.7 meters), lead raw sewage pump comes on.

Note

Step 11 assumes a dewatered wet well. If influent gate is closed with wastewater in the wet well, proceed as follows:

a. Select one pumping unit for manual operation and pump wet well down (table 7-6) to lead pump minimum operating elevation (elevation 94.9, table 7-6). Place other pumping unit mode selectors to OFF.

b. Slowly open influent gate (table 6-3) and continue to manually control pump speed until gate is fully open and wet well level stabilized between elevations 95.0 and 95.5.

c. Select desired pumping unit starting sequence and place all pumping unit mode selectors to AUTO.

12. For remote control of RSP system from CATAD control console or computer, place station CONTROL SELECTOR on MCP to CATAD, and place TCU CONTROL selector to REMOTE. For local automatic or manual pumping system control, leave station CONTROL SELECTOR to LOCAL.

13. Start up heating and ventilation system (section IX) and sump drainage subsystem (section XI).

14. Check operation of all station systems.

Table 4-3. Station Operation (Continued)

Shutdown

Total station shutdown is rare; individual systems are, however, shut down fully or in part, as necessary for maintenance or repair. Refer to the pertinent section of this manual for system/equipment shutdown procedures. If the station is to be shut down completely:

1. Place station CONTROL SELECTOR on MCP to LOCAL.

2. Slowly close influent gate (table 6-3).

3. If wet well is to be dewatered:

a. Allow RSP system to operate in automatic mode until follow pump shuts down and lead pump is running at minimum speed.

b. Shut down follow and standby pumping units (table 7-10).

c. Operate lead pump manually (table 7-6) and pump wet well down until low level alarm point (elevation 94.0) is reached and unit automatically stops. As water level drops, hose down wet well sides, gate guides, etc. When pump stops, place mode selector to OFF.

d. Isolate all pumping units (table 7-11).

e. Using a mobile or portable pump, remove water residue from wet well.

f. Install pump inlet slide gates as desired (table 6-5).

4. If wet well dewatering is not desired:

a. Allow RSP system to operate in automatic mode until follow pump shuts down and lead pump is running at minimum speed.

b. Shut down all pumps (table 7-10). Isolate as desired (table 7-11).

5. At MCC, place all circuit breakers to OFF. Padlock and tag as required.

6. AT electrical service panel, open MAIN circuit BREAKER. Padlock and tag.

7. At all station systems, latch, lock, and tag, as applicable or as required by situation, all STOP pushbuttons and ON/OFF switches.

8. Shut off natural gas and water supplies as directed by supervisor.

Table 4-4. TCU Operation

Note

See supervisor for key to TCU.

PROCEDURES

Startup (NDS TCU only)

1. At alarm (control power) PANELBOARD B inside MCP, place circuit breaker 5 to ON.

2. On test panel (inside TCU door), place AC and DC power circuit breakers to ON. AC ON light comes on.

3. On TCU door, place TCU CONTROL selector to REMOTE.

CAUTION

Lamps stay on for 15 minutes after LAMPS pushbutton is pressed. Do not attempt to shut them off manually or TCU damage may result.

4. On TCU door, press LAMPS pushbutton. Status indicators 1, 2, 3, and PC 1 come on. Status indicators 8, 9, 10, 31, 32, and 33 may come on depending on RSP system status.

Note

If status indicators other than those cited above come on either before or after LAMPS pushbutton is pressed, notify supervisor or CATAD central console operator.

Shutdown

Note

Partial shutdown for short-term servicing or maintenance of RSP system is covered by steps 1 and 2 below.

1. Notify WPTP and CATAD central console operator that TCU is to be shut down and give estimate of probable duration.

2. At TCU front panel, place TCU CONTROL selector to LOCAL. RSP and wet well level "command" relays are deenergized and TCU only monitors.

3. At MCP, place station CONTROL SELECTOR to LOCAL. CATAD is locked out and RSP system reverts to station local control.

4. On test panel inside TCU door, place AC and DC power circuit breakers to OFF. AC ON light goes out.

5. At alarm (control power) PANELBOARD B inside MCP, place circuit breaker 5 to OFF.

ALARM SYSTEM

Physical Description

Alarm system equipment (figure 4-4) includes a local annunciator, alarm sensors, the Metrotel transmitter cabinet, and the explosive gas hazard monitor subsystem. Table 4-5 lists equipment characteristics.

The Metrotel transmitter cabinet, on the southeast wall of the control room, contains a transmitter and 12-volt mercury battery for emergency power. the WPTP outlying facilities annunciator panel is in the pump building control room at WPTP. For each outlying facility, the panel has three alarm lamps: power failure, carrier signal loss, and station trouble, which are lighted as long as the facility functions normally. Refer to the plant O & M manual for more detailed panel information.

The explosive gas hazard alarm is the only one not associated with specific equipment or system malfunctions. The explosive gas sensors are on the wet well wall; the gas level monitor is on the MCP (figure 4-4).

Functional Description

The alarm system provides visual indication of individual system malfunctions on the MCP annunciator and transmits priority one and two alarms to WPTP for corrective action (figure 4-5). Two malfunctions, power failure and pump room flood, are priority one conditions. High wet well level and closing of the influent gate (see Note below) are priority two conditions. All other faults trigger local MCP annunciator indications only.

Note

Influent gate closure is indicated at CATAD and WPTP only. There is no MCP annunciator indication.

If any monitored system malfunctions, the appropriate sensor activates the alarm circuit, lighting the corresponding window on the local annunciator. The appropriate priority alarm is also transmitted to WPTP via Metrotel, extinguishing the applicable lamp on the outlying facilities annunciator panel, sounding a horn or buzzer, and starting the plant alarm digital recorder. The recorder prints out the time, date, nature of the alarm, and the time the alarm is cleared. If the fault clears itself, the local annunciator window stays lighted until the faulty system is inspected and the alarm RESET pushbutton pressed to clear the indication from the panel. The East Marginal Way pumping system is Metrotel transmitter station number 1W and transmits on a frequency of 565 Hz.

The explosive gas hazard transmitters trigger wet well EXPLOSION HAZARD MONITOR alarm AL 9 whenever gas concentration exceeds a predetermined safe level. The monitor displays the explosive limit (L.E.L), graduated from 0 to 100 percent L.E.L. The alarm relays are reset automatically or manually. The explosive gas hazard subsystem will not function in an oxygen-deficient atmosphere. Check suspect areas with an oxygen deficiency meter before accepting gas hazard monitor readings.

Alarm Indications

The explosive gas hazard alarm (AL 9) is the only local fault indication not associated with a particular functional system. Table 4-6 lists actuation points and corrective action for only those alarms or faults associated with the alarm system itself. For other alarms, see similar tables in those sections describing the functional systems related to the specific fault indication.

Operator Services

Periodic alarm system checks and services performed by station operators are listed in table 4-7.

Operating Procedures

The East Marginal pumping station is fully automatic and not normally manned. Equipment is monitored by the local alarm system and certain fault indications are transmitted via Metrotel to WPTP and CATAD. A pump station crew reports daily to the station. Local alarm system operating procedures are included in table 4-7.

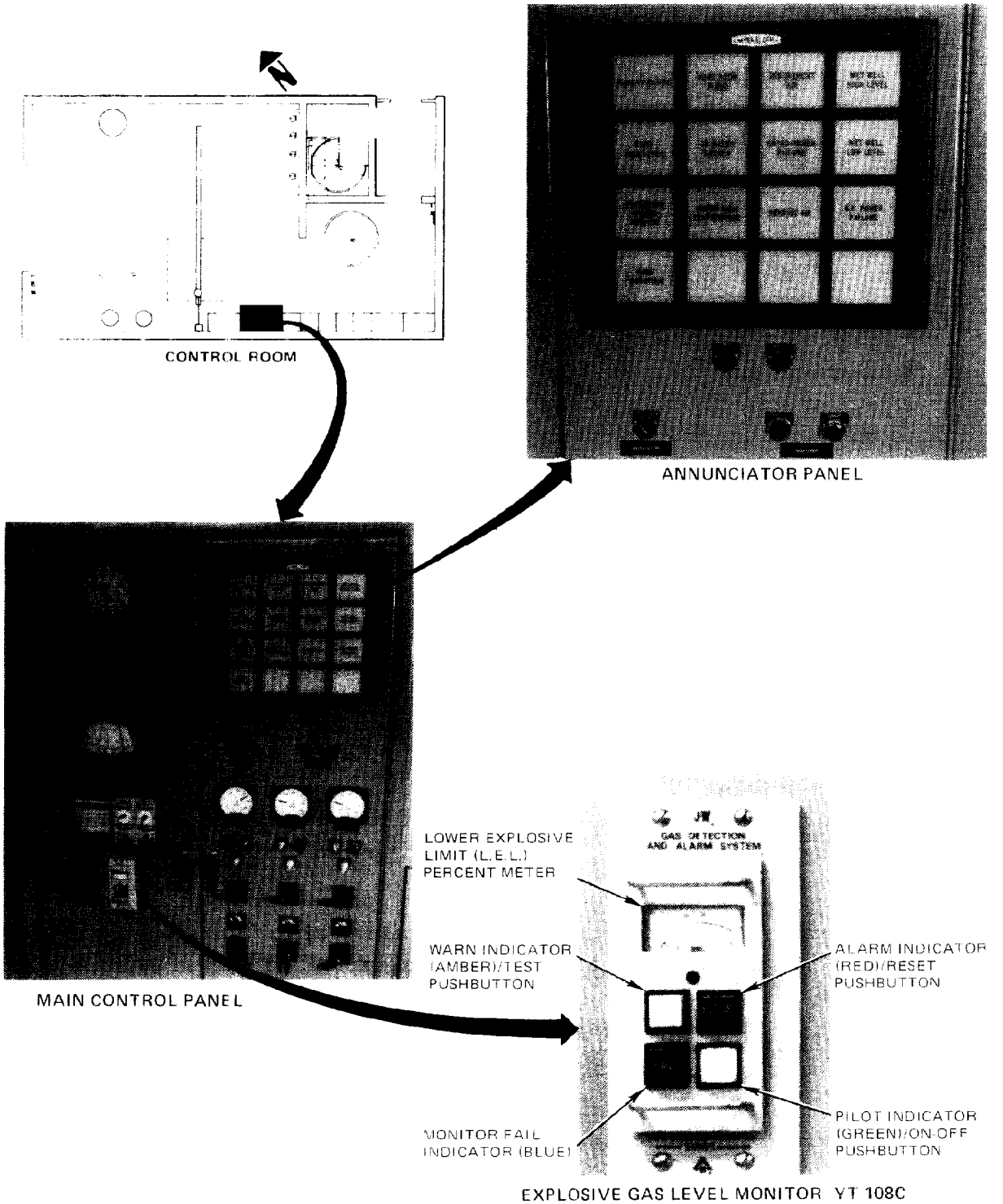


Figure 4-4. Alarm System Equipment (Sheet 1 of 2)

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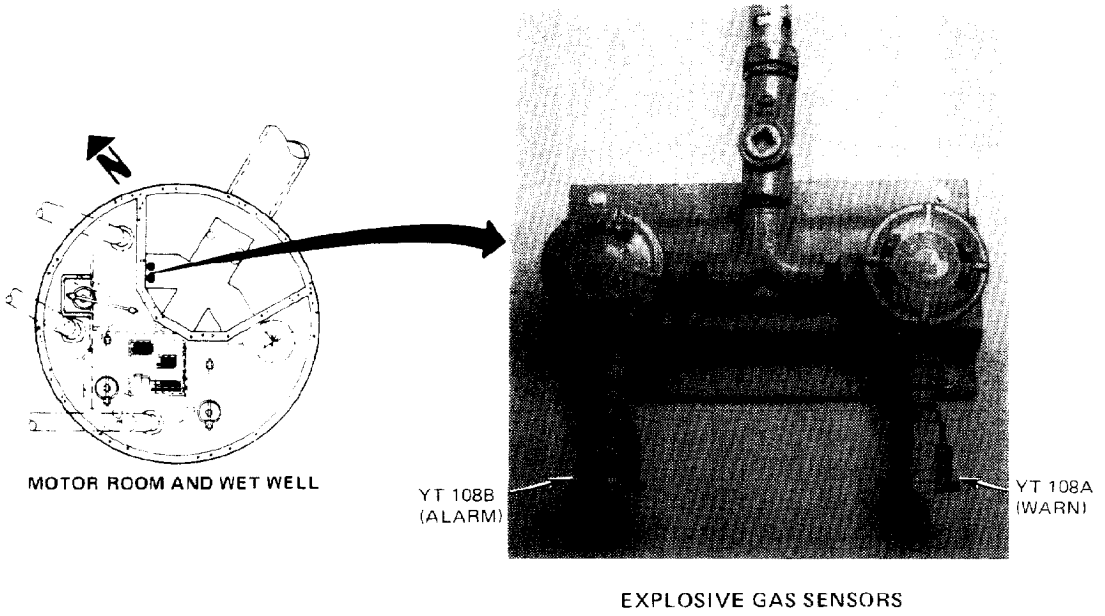

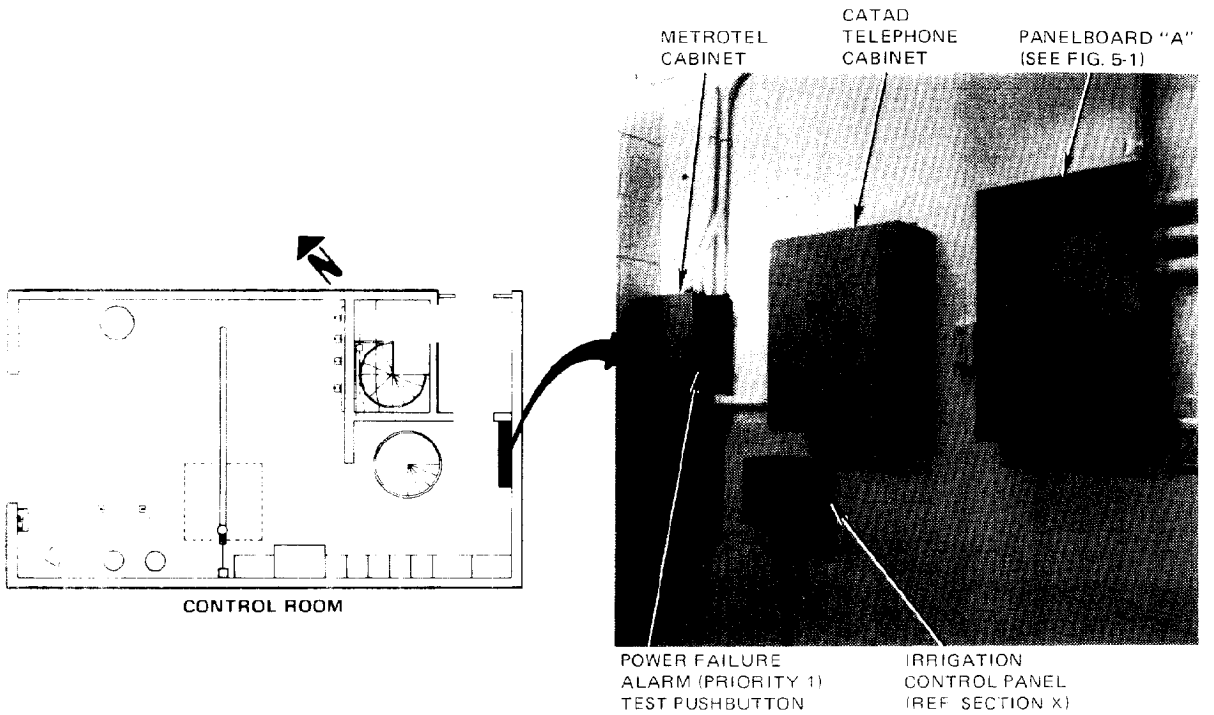

Figure 4-4. Alarm System Equipment (Sheet 2 of 2)

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Table 4-5. Alarm System Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
MAIN CONTROL PANEL:		
Annunciator Panel		Panalarm model 51B44; 16 windows; two lamps wired in parallel per window with 120-volt bulbs
Explosive Gas Level Monitor	YT-108C	Bacharach Instrument Company, Division of AMBAC Industries, model CD 830 P, 60 Hz, 115 V, 15 Watts
Explosive Gas Hazard Transmitter	E/I 108D	Moore Industries, model MVT millivolt transmitter; input – 0 to 1 Vdc; output – 4 to 20 ma
WET WELL:		
Explosive Gas Sensors (2)	YT-108A YT-108B	Bacharach Instrument Company, assembly No. 0023-4012, element No. 800-080.2, class 1, division 1, group BCD

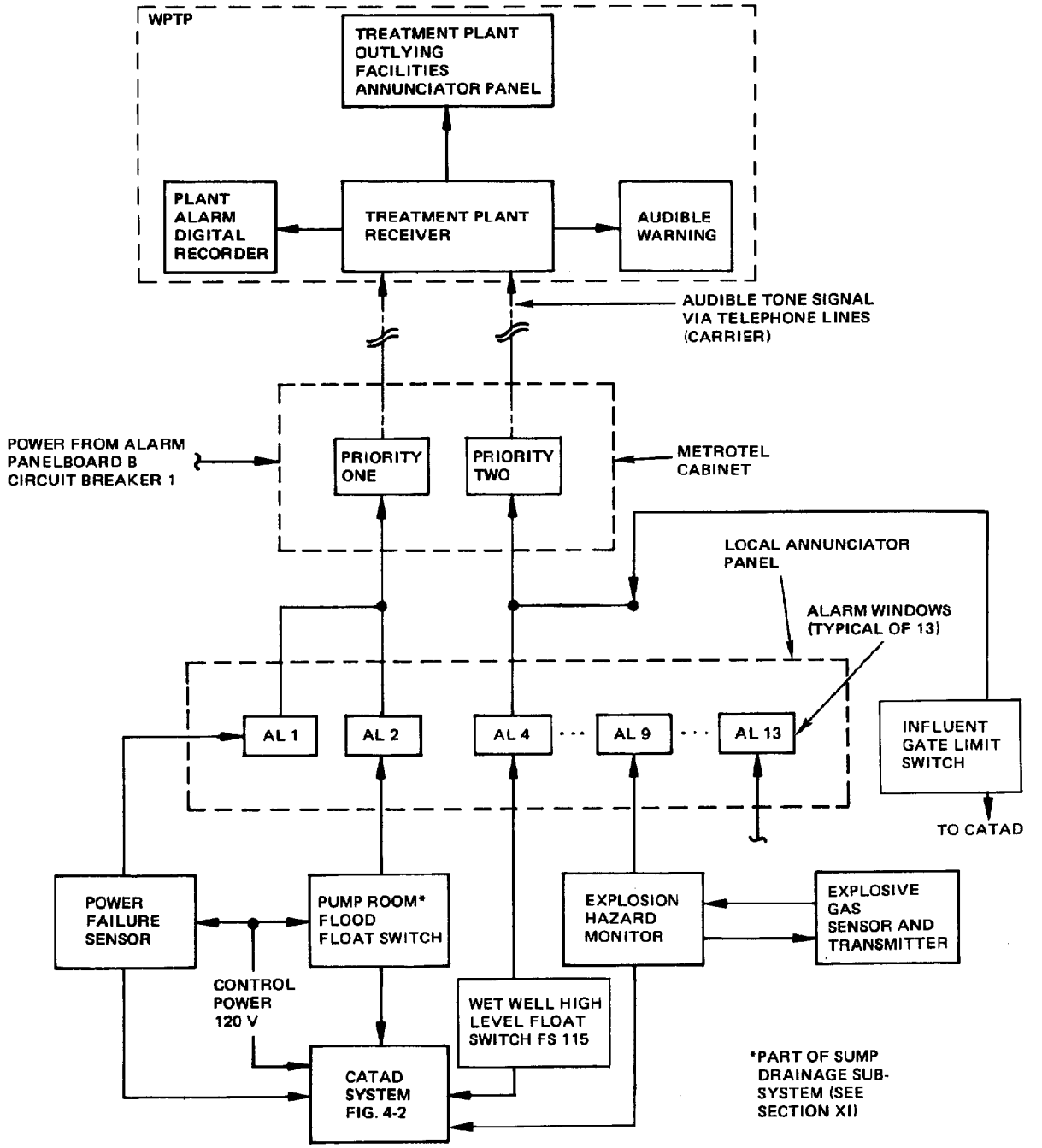


Figure 4-5. Alarm System Simplified Diagram

Table 4-6. Alarm System Alarm Indications

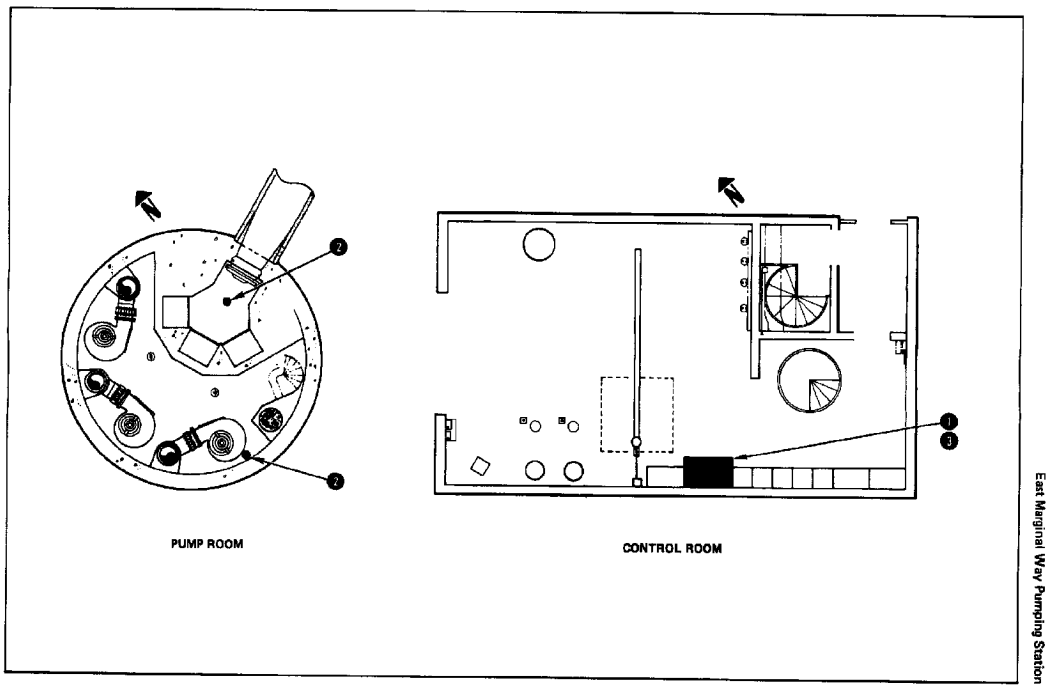
ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
MAIN CONTROL PANEL:			
EXPLOSION HAZARD MONITOR (AL 9)	In wet well, explosive gas hazard transmitter	At or above high-explosive gas level setpoint. **Note** *Sensor head can absorb too much moisture giving a false reading, evidenced by a gradual, instead of rapid, readout increase.*	**WARNING** *Do not enter wet well access room when alarm is on. Injury or death may result.* Verify that wet well ventilation system is operating. If ventilation system is operating, alarm should clear (red indicator on gas monitor goes out; green indicator stays on). If not, notify supervisor. If alarm clears, press alarm RESET pushbutton to clear annunciator window. Record alarm in station log.
Metrotel power failure (power indicator on Metrotel panel goes out)	Carrier signal (565 Hz) disappears. East Marginal Way PS carrier failure indicator on WPTP outlying facilities panel goes out.	Ac power loss to Metrotel transmitter.	Metrotel transmitter should shift to emergency power. Check that circuit breaker 1 in alarm (control power) PANELBOARD B (see figure 5-1) is ON. If breaker is OFF, check station log to determine reason. If none is found, place breaker to ON. If breaker trips and/or power fails again, place to OFF and notify supervisor. Record actions in station log.
Explosive gas monitor malfunction:	Internal	– – –	See figure 4-4, sheet 1 of 2.
FAIL indicator (blue) on			Notify supervisor or WP division instrument technician.
PILOT indicator (green) not on			Press TEST pushbutton. Meter should indicate full scale; WARN (amber) and ALARM (red) indicators should come on. If so, replace PILOT indicator bulb. If not, check that circuit breaker 6 in alarm PANELBOARD B is on; then press monitor ON/OFF switch. If monitor does not come on, or malfunctions, notify supervisor or instrument technician.
Meter pointer off scale to right; FAIL or ALARM indicator on at the same time			Notify supervisor or instrument technician.

Table 4-7. Alarm System Operator Services

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY			**Note** *Record all actions in station log.*
1. At Main Control Panel:			**WARNING** *If EXPLOSION HAZARD MONITOR alarm (AL9) is on, DO NOT enter wet well access room; failure to comply can result in injury or death.*
1a. Check annunciator panel for alarm indications.	1a. No window illuminated.	1a. One or more windows illuminated.	1a. Investigate source and cause of alarm(s). After correcting problem(s), press alarm RESET pushbutton to clear annunciator panel.
1b. Test annunciator panel lamps by pressing TEST pushbutton.	1b. All lamps come on.	1b. Other than normal.	1b. Replace defective lamps and retest; if they still do not come on, notify Operations Supervisor.
1c. Check explosive gas level monitor.	1c. PILOT (green) indicator on; FAIL (blue) indicator off; WARN (amber) and ALARM (red) indicators off unless panel meter indicates presence of explosive gas in wet well.	1c. Other than normal.	1c. See table 4-6 (explosive gas level monitor malfunction). If unable to rectify problem, notify supervisor or instrument technician.
WEEKLY			
2. Test Metrotel alarms each Thursday and Friday.	– – –	– – –	– – –

Table 4-7. Alarm System Operator Services (Cont.)

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
WEEKLY (Cont.) Note *Metrotel priority one alarms are power failure and pump room flood. Priority two alarms are wet well high level and influent gate closure. Usually, half of the alarms are tested each day.*			
2a. In pump room, lift pump room flood float switch to maximum height to trigger priority 1 alarm. Note *Priority 1 alarm can also be tested by interrupting power to Metrotel transmitter which simulates station power failure (see section V, table 5-6).*	2a. Annunciator PUMP ROOM FLOOD window (AL 2) comes on. Treatment plant acknowledges alarm.	2a. Other than normal.	2a. Notify supervisor.
2b. In wet well, lift high wet well float switch FS 115 to maximum height to trigger priority 2 alarm.	2b. Annunciator WET WELL HIGH LEVEL window (AL 4) comes on. Treatment plant acknowledges alarm.	2b. Other than normal.	2b. Notify supervisor.
3. At explosive gas level monitor on main control panel, press and hold down TEST (amber) pushbutton.	3. Meter indicates full scale; WARN and ALARM indicators come on; local and remote alarms are triggered.	3. Other than normal.	3. See table 4-6 (explosive gas level monitor malfunction). If unable to rectify problem, notify supervisor or instrument technician.



East Marginal Way Pumping Station

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ELECTRICAL
POWER SYSTEM

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SECTION V
ELECTRICAL POWER SYSTEM

INTRODUCTION

The East Marginal Way pumping station normally receives power from Seattle City Light from an overhead distribution line through two pole-mounted, 300-kva transformers east of the station. Two feeders connect the transformer secondaries to the station service panel. Electrical loads are distributed through protective and control devices in the motor control center (MCC). If utility power fails, a mobile generator serves the station through an automatic transfer switch.

PHYSICAL DESCRIPTION

The station electrical power system consists of the equipment shown in figure 5-1. Table 5-1 lists major equipment characteristics.

Utility Power Equipment

The Seattle City Light transformer bank consists of two 3-phase, 300-kva transformers that convert transmission voltage to 460 volts. The bank secondary (460 volt) is solidly grounded to the station ground grid.

WARNING

The pole-mounted transformer bank is maintained by Seattle City Light crews. Under no circumstances are Metro personnel to attempt to service them. Failure to comply can result in death or injury.

Service Panel

The service panel has three compartments. In the upper compartment (RELAY METER PANEL) are a voltmeter and ammeter, each with a phase selector, phase failure and undervoltage relays and metering transformer blown fuse indicators. In the center compartment (MAIN BREAKER) is the station 600-ampere main circuit breaker. The lower compartment houses the service panel metering transformers. The service panel and components are used whether power is received from Seattle City Light or the mobile generator.

Transfer Panel

The transfer panel has two compartments. In the upper compartment (TRANSFER SWITCH) is the power transfer switch, transfer circuit control power transformers, and simulated outage controls and indicators. The lower compartment houses the generator and load bank circuit breakers.

Motor Control Center (MCC)

The MCC or 460-volt distribution equipment consists of individual components housing motor controllers, relays, contactors, and circuit breakers (see figure 5-1). A typical motor controller consists of a manually and electrically operated circuit breaker, line starter with overload protection, control power transformer with primary and secondary fuse indicators, reset pushbutton, and as applicable, an hourmeter, power indicators, and mode selectors.

Low-Voltage Distribution Equipment

Included in this category are the lighting and control/alarm power transformers, panelboards A, B, and C (lighting and power, MCP control/alarm, and 24-Vdc transfer circuit control, respectively) and the 24-Vdc control power batteries and charger.

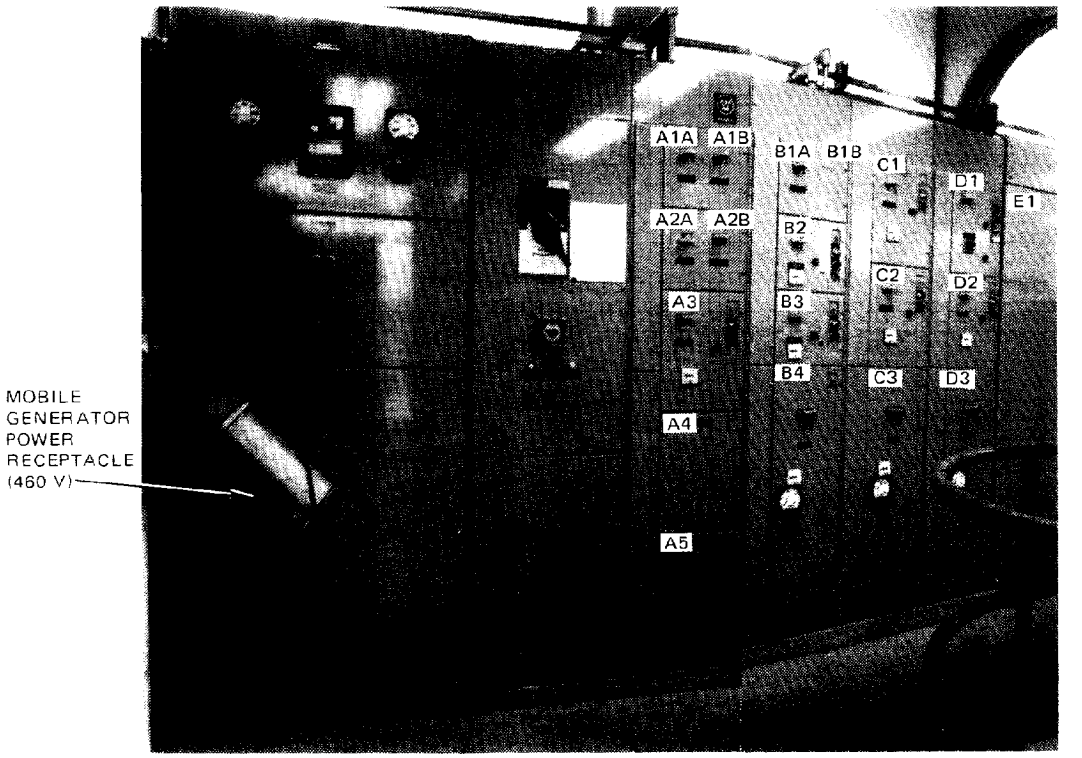
FUNCTIONAL DESCRIPTION

Service Panel

WARNING

The pole-mounted transformers outside the station fence are maintained by Seattle City Light crews. Under no circumstances are Metro personnel to attempt to service them. Failure to comply can result in death or injury.

The East Marginal Way pumping station receives power from either Seattle City Light or a mobile generator set (figure 5-2). Two feeders normally carry 460-volt power from the secondary of the utility's pole-mounted transformers to the MAIN circuit BREAKER in the service panel. The circuit breaker provides automatic fault protection for the MCC bus when being supplied from the utility and may be manually operated. The 460- to 120-volt potential transformers in the bottom compartment of the service panel serve the phase failure and undervoltage relays, and the input power voltmeter and ammeter. The voltmeter measures the input voltage whether supplied by the utility or mobile generator. The voltmeter selector



MCC PANEL LAYOUT

UNIT NO.	EQUIPMENT	LOAD SERVED
A1A	Circuit breaker	Monorail (Control Room) Hoist
A1B	Circuit breaker	Control Power Transformer
A2A	Circuit breaker	60-ampere Outlet
A2B	Circuit breaker	Bus Capacitor
A3	Motor controller	Sump Pump
A4	Relays	Transfer Circuit
A5	Alternator	Service Air System
B1A	Circuit breaker	PANELBOARD A via Lighting and Power Transformer
B1B	Blank	Blank
B2	Motor controller	Instrument Air Compressor 1
B3	Motor controller	Instrument Air Compressor 2
B4	Motor controller	Raw Sewage Pump 1

Figure 5-1. Electrical Power System Equipment (Sheet 1 of 4)

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UNIT NO.	EQUIPMENT	LOAD SERVED
C1	Motor controller	Service Air Compressor 1
C2	Motor controller	Service Air Compressor 2
C3	Motor controller	Raw Sewage Pump 2
D1	Motor controller	Air Ventilating (Handling) Unit
D2	Motor controller	C2 Water Pumps
D3	Motor controller	Raw Sewage Pump 3
E1	Eddy current coupling controllers (3)	Raw Sewage Pumps 1, 2, and 3
Service Panel (upper)	Relays and indicators	Station
Service Panel (middle)	Main circuit breaker	MCC bus through transfer switch
Service Panel (lower)	Metering transformers	Voltmeter, ammeter, and relays in upper service panel compartment
Transfer Panel (upper)	Transfer switch	MCC bus
Transfer Panel (lower)	Standby generator and load bank circuit breakers	MCC bus through transfer switch

Figure 5-1. Electrical Power System Equipment (Sheet 2 of 4)

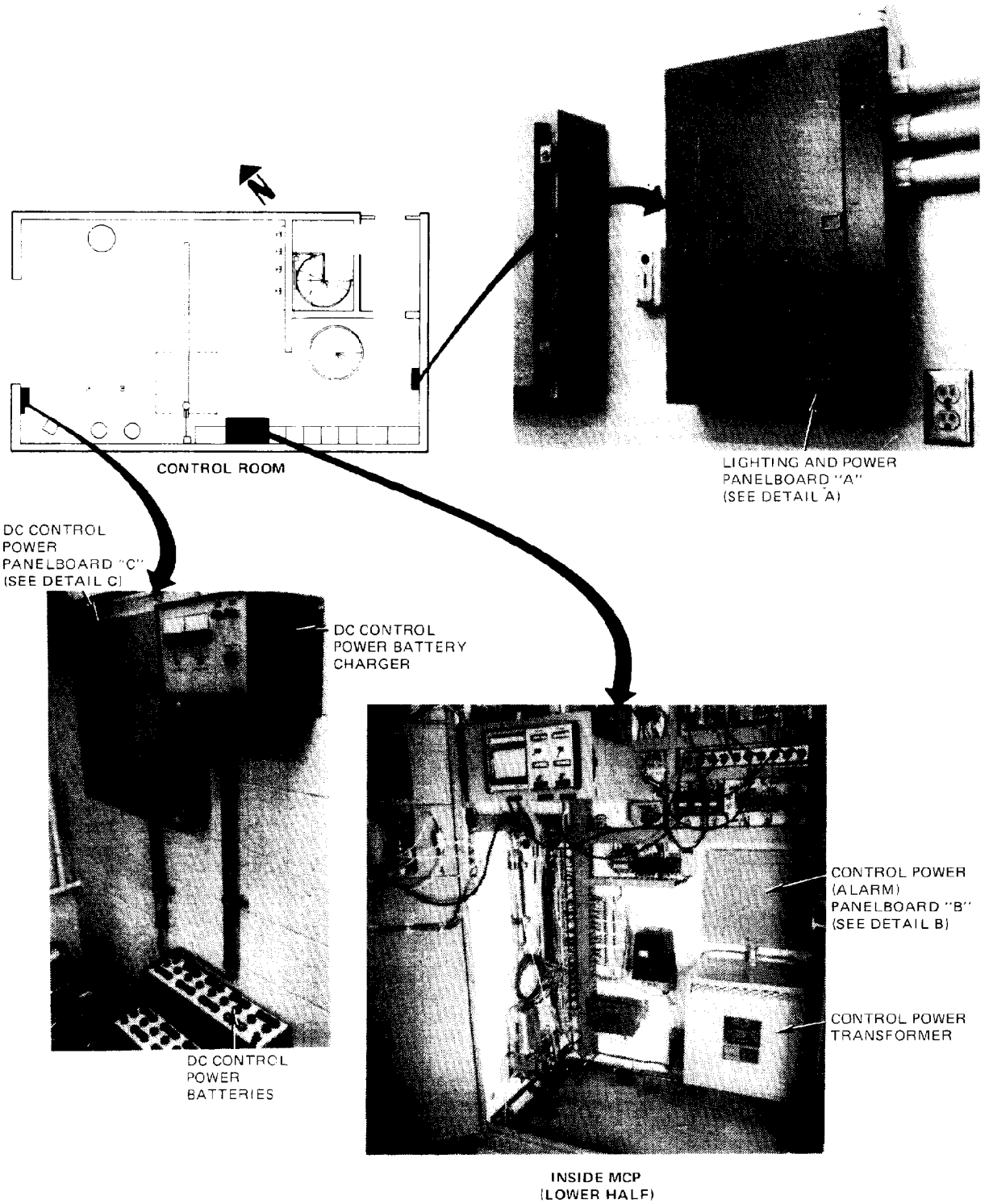

Figure 5-1. Electrical Power System Equipment (Sheet 3 of 4)

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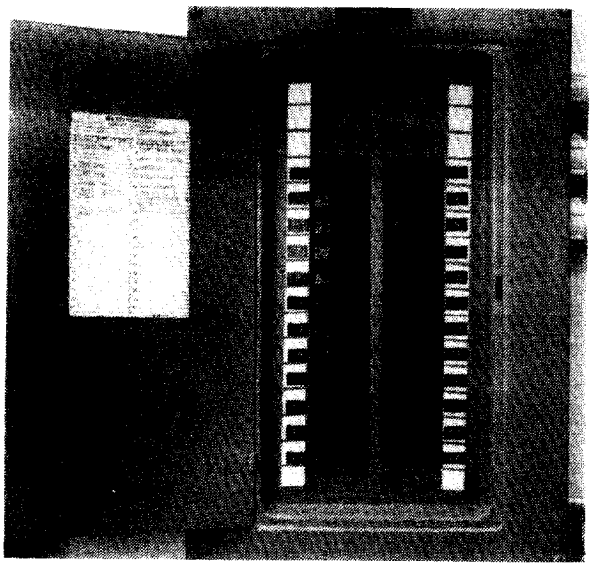
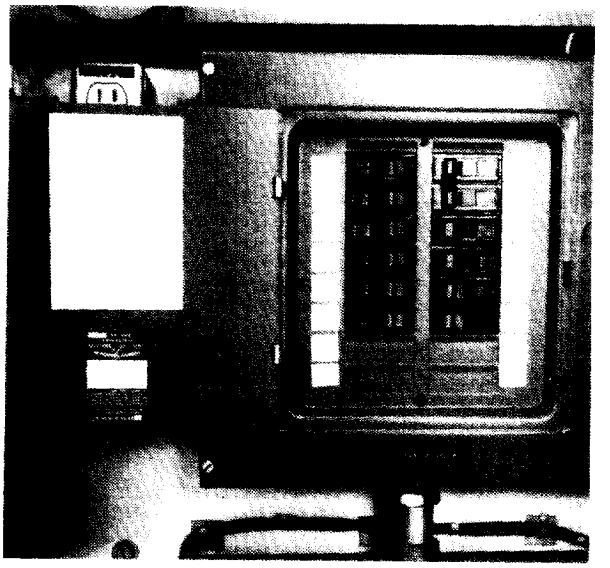
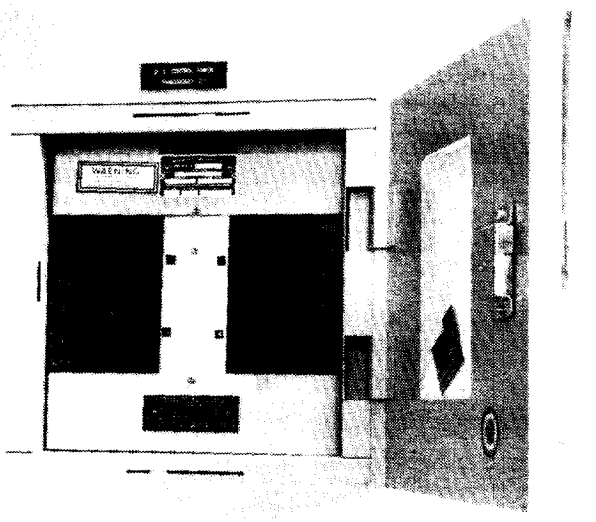
MOTOR ROOM AND WET WELL



DETAIL A
PANELBOARD "A"



DETAIL B
PANELBOARD "B"



DETAIL C
PANELBOARD "C"

Figure 5-1. Electrical Power System Equipment (Sheet 4 of 4)

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Table 5-1. Electrical Power System Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
Motor Control Center		Westinghouse Electric Corporation type W
Automatic Transfer Switch		Westinghouse Electric Corporation style no. 60E0097, Catalog No. ATS-A3600-0; rating – 600 amperes, 3-wire, 3-phase, 60-Hz, 460 V
Lighting and Power Transformer		H. K. Porter Company, Inc. air-cooled tranformer type SG6, number 182678; rating – 15 kva, 3-phase, 480 V delta to 208/120 V Y
Control Power Transformer		Tierney Electrical Mfg. Co. air-cooled transformer type GI-1, Catalog No. ACL105-8Y13H80; rating – 5-kva, single-phase, 60-Hz, 400 to 120/210 V
Lighting and Power Panelboard A		Bryant Electric Company with 24 Bryant type BR, Model BR120CU-AL circuit breakers
Control Power (Alarm) Panelboard B		Bryant Electric Company with 10 Bryant type BR, Model BR115CU10-14 15-ampere circuit breakers and two HBR240 type BRCU4-14 40-ampere circuit breakers
DC Control Power (Transfer Circuit) Panelboard C		Westinghouse Electric Corporation panelbooard number BD340397, type WEB; rating 100 amperes at 24 Vdc; with four Westinghouse Model EB2020, 2-pole, 20-ampere circuit breakers
DC Control Power Battery Charger		Ratelco Inc. precision type VR24122; maximum output – 22 amperes at 24 Vdc
DC Control Power Batteries		Nife Model MDP-7, nickel-cadmium pocket plate alkaline type; eighteen-1.42-volt batteries connected in series; nominal cumulative capacity – 70 ampere-hours at 25.2 Vdc
Bus Capacitors (2)		General Electric Company Catalog Nos. 55F315AD and 15F164G2; rating – 20 KVAR, 60-Hz, 3-Phase, 460 V
Receptacle, Mobile Generator Connection		Crouse-Hinds Company type 900, Catalog No. AR4042; rating – 400 amperes at 250 Vdc/600 Vac
Receptacle, Welding		Crouse-Hinds Company Model M54, Catalog No. AR-648; rating – 60 amperes at 250 Vdc/600 Vac

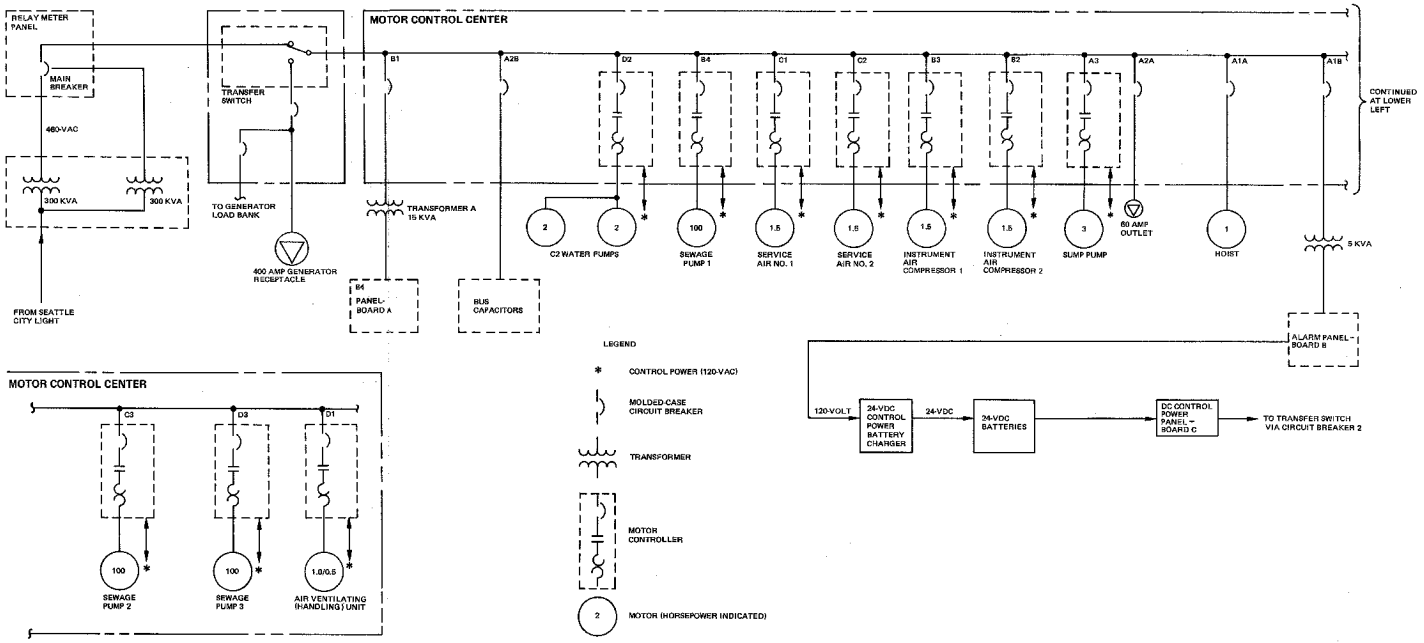

Figure 5-2. Electrical Power System Simplified Diagram

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selects the specific power source and phase to be monitored. The panel ammeter measures each phase of incoming utility current only.

The phase failure relay detects abnormal differences in the magnitude and phase relations of the line-to-line voltages at the main bus. The undervoltage relay detects drops in magnitude or absence of utility main bus voltage. These circuits are arranged so that the undervoltage relay supply is cut off by the phase failure relay. Undervoltage relay operation triggers local and remote power failure alarms. A time delay between undervoltage relay detection of low voltage levels and relay operation allows brief voltage dips to be ignored.

Note

When a standby generator is permanently installed at the station, undervoltage relay operation will also trigger automatic generator startup and power transfer.

Transfer Panel

Normally (TRANSFER SWITCH to NORMAL), power is routed from the MAIN circuit BREAKER through the transfer switch to the MCC 460-volt bus. During a power failure, the transfer switch is rotated to EMERGENCY and power is supplied to the bus from a mobile generator connected to the 460-volt power receptacle in the control room through the STANDBY GENERATOR circuit breaker. Control power transformers in the transfer panel step down 460 volts to 120 volts for transfer circuit relay operation, while the 24-Vdc control batteries provide power to the transfer switch control circuits through D.C. CONTROL POWER PANELBOARD C circuit number 2.

The STANDBY GENERATOR circuit breaker in the lower compartment of the panel connects the mobile generator receptacle through the transfer switch to the MCC bus and is normally closed. The LOAD BANK circuit BREAKER connects the generator to load bank facilities for testing and is normally open. A mechanical interlock between the two breakers ensures that only one breaker is closed at a time.

Motor Control Center (MCC)

The MCC bus is energized whether the station is fed from the utility or the mobile generator.

Note

When a standby generator is permanently installed at the station, the UTILITY POSITION and STANDBY POSITION indicators on the transfer panel will come on to indicate the power source. These indicators are not now connected.

Power is distributed from the MCC bus through circuit breakers, circuit breakers and motor controllers, and circuit breakers and contactors to specific station loads.

The circuit breakers automatically open for cable and equipment fault protection, and may be manually opened, closed, and locked out as well. A line starter unit in each motor controller compartment supplies power to motor drive and control circuits and provides automatic thermal overload protection. The starter consists of an electromagnetically actuated and held contactor, thermal overload relays, control relays and devices, and control circuit primary and secondary fuses. The hourmeter on each motor controller records the cumulative motor operating time. Green and red indicators show whether the motor is ready to start or is running already. The RESET pushbutton resets the starter contactor after a thermal overload to permit restarting the motor. The blown fuse indicator comes on when the control circuit secondary fuse has blown.

Note

The mobile generator is normally connected and started by a maintenance section electrician who also monitors operation, etc.

Low Voltage Distribution Equipment

The lighting and power transformer (figure 5-1, sheet 3 of 3) receives 460-volt power through MCC compartment B1A and steps it down to 240/120 volts to serve lights, single-phase motors and low-voltage receptacles through PANELBOARD A. The control power transformer inside the MCP also steps down 460 volts to 120 volts and serves the MCP, the TCU and station control and alarm-related circuits through alarm PANELBOARD B. D.C. CONTROL POWER PANELBOARD C distributes 24-vdc power from the dc control batteries to the transfer switch control circuits. The batteries are kept charged by the control power battery charger served through circuit 8 of alarm PANELBOARD B. Panelboard circuit breaker assignments are listed below. Refer also to figure 5-2.

LIGHTING AND POWER PANELBOARD A

Ckt. No.	Assignment
1	Spare
2	North lights
3	Motor and pump room lights
4	Control room entry lights
5	Wet well lights
6	Control room receptacles
7	Spare
8	Work bench receptacle
9	208-volt receptacle
10	Spare
11	208-volt receptacle
12	Water heater
13	Spare (marked "Intake Fan")
14	Irrigation sprinkler controller
15	Motor and pump room receptacles
16	Wet well exhaust, wet well transfer, and entry ventilation fans
17	Spare
18	Control room exhaust fan
19	Service air compressors alternator motor
20	Motor room exhaust fan

CONTROL POWER (ALARM) PANELBOARD B

Ckt. No.	Assignment
1	Essential control
2	Panelboard main disconnect
3	MCP clock
4	Panelboard main disconnect
5	TCU power
6	MCP instrument receptacle strip/RSP control circuit
7	MCP heater and 120 Vac receptacles
8	DC control power battery charger
9	Spare
10	Spare
11	Motor room exhaust fan vent control
12	Spare

DC CONTROL POWER PANELBOARD C

Ckt. No.	Assignment
1	Blank
2	Transfer control circuits
3	Blank
4	Blank

Utility Power Loss

If utility power fails, alarms are indicated at both local and remote annunciator panels. Locally, MCP annunciator window AL 1 (POWER FAILURE) lights. A priority 1 alarm is transmitted by Metrotel to the outlying facilities annunciator at WPTP; the alarm also registers at the CATAD central control facility.

A mobile generator is connected to the 460-volt receptacle on the southeast wall (figure 5-1). The generator is started and essential station loads manually transferred (table 5-7). When utility power is restored, load retransfer and generator shutdown are likewise done manually.

Note

When a standby generator is permanently installed at the station, generator startup/shutdown and load transfer/retransfer will occur automatically. Simulated outage controls and indicators on the MCP will then also be operational.

ALARM INDICATIONS

Table 5-2 lists the alarms monitored on the station main control panel annunciator and the WPTP outlying facilities annunciator panel and their corrective action.

OPERATOR SERVICES

Periodic operator-performed electrical power system services are listed in table 5-3. An illustration at the end of the table shows where the services are performed.

OPERATING PROCEDURES

Electrical power system operating procedures are in tables 5-4 through 5-7. See figure 5-1 for location of equipment, controls, and indicators.

Table 5-2. Electrical Power System Alarm Indications

ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
			Note *Record all actions in station log.*
AT MCP ANNUNCIATOR:			
POWER FAILURE (AL 1) **Note** *Ac and dc power failure alarms are also transmitted to CATAD central control facility.*	Phase failure and undervoltage relays (TCU contact 5)	Loss of normal utility power or extreme phase shift	Call Seattle City Light to get estimated outage time. Request mobile generator from WPTP, connect to generator receptacle in control room, and start up (table 5-7). **Note** *Generator is normally connected and started by maintenance section electricians only. However, operators may sometimes be required to do so. The station must be manned by either an operator or electrician during entire power outage to monitor generator operation and for unit shutdown.* *Load transfer from utility line to generator, retransfer to utility source, and generator shutdown are all done manually pending future installation of an onsite standby generator. Press MCP alarm RESET pushbutton to clear annunciator.*
D.C. POWER FAILURE (AL 12)	Dc undervoltage relay TR 185 (TCU contact 15)	Below preset voltage level	Check control power batteries. Service if necessary. Check battery charger. If not operating properly, notify supervisor. Record actions in station log.
AT WPTP OUTLYING FACILITIES ANNUNCIATOR:			
Priority One Alarm Indicator Drops Out	Phase failure and undervoltage relays	Loss of normal utility power or extreme phase shift	Call Seattle City Light to get estimated outage time. Send crew to station with mobile generator. Upon completion of mobile generator startup and power transfer, the priority one indicator should come on again. If the priority one and priority two indicators both remain off, the mobile generator has failed.

Table 5-3. Electrical Power System Operator Services

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
			Note *Record all actions in station log.*
DAILY			
1. At motor control center (MCC):			
1a. Check circuit breaker positions for all operating systems.	1a. Circuit breakers closed.	1a. One or more circuit breakers open or tripped.	1a. If circuit breaker is open and not locked out, determine reason and close breaker. If breaker has tripped, examine equipment for obvious damage; then reset circuit breaker. If breaker trips again, lock out unit and notify supervisor.
1b. Test individual indicators on each motor controller by pressing lamp.	1b. All indicators come on.	1b. One or more indicators do not come on.	1b. Replace defective bulbs.
1c. Test indicators on transfer panel by pressing each lamp.	1c. All indicators come on.	1c. One or more indicators do not come on.	1c. Replace defective bulbs.
1d. Record hourmeter readings for all equipment. Also record current (AC AMPERES) reading for each operating raw sewage pump.	– – –	– – –	– – –
2. At service panel, check each phase of utility voltage and current and record readings.	– – –	– – –	– – –
3. Check operation of dc control power battery charger.	3. Charger operating; POWER ON indicator on. Voltmeter indicates nominal 24 volts; ammeter indicates slightly.	3. Other than normal.	3. Place battery charger power switch to on position (up). If switch is to on, but charger is not operating, check that circuit breaker 8 in CONTROL POWER (ALARM) PANELBOARD B is ON. If charger malfunctions, notify supervisor.
4. At all pumping station levels, replace any defective light bulbs or tubes.	– – –	– – –	– – –

Table 5-3. Electrical Power System Operator Services (Cont.)

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
MONTHLY			
5. At dc control power batteries and charger:			
5a. Clean batteries and terminal connections.	– – –	– – –	– – –
5b. Remove battery caps and check electrolyte level.	5b. Electrolyte at proper level.	5b. Electrolyte below proper level.	5b. Add distilled water to proper level.
5c. Equalize batteries for 4 to 6 hours using procedure in table 5-8.	– – –	– – –	– – –
6. At Metrotel cabinet (figure 4-4), press power failure alarm test pushbutton to trigger priority one alarm at WPTP outlying facilities annunciator panel.	6. Priority one power failure alarm is triggered at WPTP. Plant acknowledges alarm.	6. Alarm is not triggered at WPTP.	6. Notify supervisor.
QUARTERLY			
7. At dc control power battery charger, blow dirt and dust and other foreign matter from inside the charger.	– – –	– – –	– – –

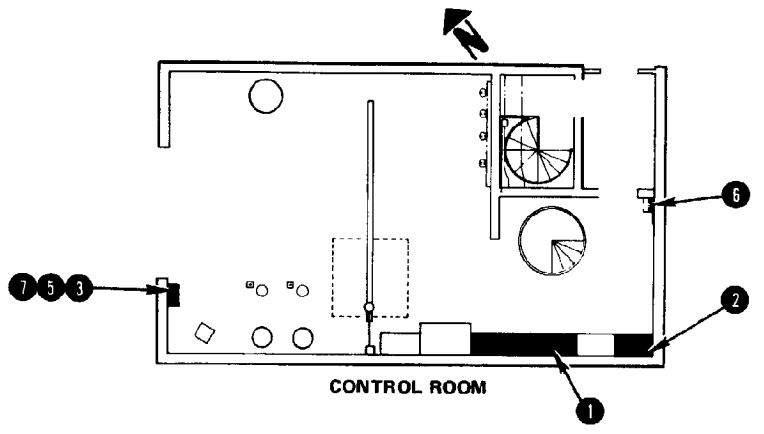

Table 5-4. Electrical Power System — Lockout of 460-volt Equipment at MCC

PROCEDURE

WARNING

Do not energize equipment displaying a lockout tag without permission of supervisor. Failure to comply can result in death or injury.

Note

All 460-volt electrical equipment load circuit breakers at the MCC are three-position (ON/TRIPPED/OFF) and are similar in operation. Up to three padlocks may be placed on a single unit.

1. Place circuit breaker to OFF.

2. Push locking bar horizontally to right, extending it from its recess in circuit breaker handle.

3. Install padlock with lockout tag through lockout bar and close securely.

4. Remove key from padlock and keep key on person. (See COMMENT for disposition of key).

5. Write name and date on lockout tag.

6. To restore power, perform the following steps:

a. Clear intent with supervisor; or if during maintenance work, with person whose name appears on tag.

b. Remove lock and lockout tag from circuit breaker.

c. Place circuit breaker to ON.

d. Return lock and lockout tag to storage on a spare motor controller.

COMMENT

The person starting work on the equipment locks out and tags the circuit breaker on the appropriate motor controller and keeps the key. Locks and lockout tags are hung on a spare motor controller. If a second person starts work on the same equipment, he too locks out the circuit breaker with another padlock and tag, leaving the first lock and tag in place; he then keeps his key. Keys may be passed from one person to another, as necessary. If it imperative to start the equipment and the person with the key is not available, the supervisor may unlock the breaker with a master key.

Table 5-5. Electrical Power System — Station Electrical Isolation

PROCEDURES

Emergency Isolation

1. Notify supervisor of need to isolate station. Determine station downtime and estimate how much time is left before station overflow. If the station is shut down while pumping at 11 mgd (41,635 cu m/day), the 54-inch (137-cm) influent sewer has about 2 hours of storage time; during storm conditions, less than 15 minutes.

2. On service panel (middle section), open and tag MAIN circuit BREAKER.

3. At main control panel, place raw SEWAGE PUMP (RSP) mode (HAND/OFF-RESET/AUTO/PUMP DN) selectors to OFF (see section VII).

4. If desired, close the influent gate (table 6-3). Leaving the gate open, however, will flood the wet well, which can help predict station overflow. At station overflow, the wet well is flooded 6 inches (15.2 cm) above floor level (elevation 100.5) or an influent channel depth of about 8 feet (2.4 m).

Returning Station to Operation

1. Notify supervisor that station is returning to normal operation.

2. At service panel (middle section), remove lockout tag from MAIN circuit BREAKER and place breaker to ON.

3. At main control panel (MCP), select one pumping unit for manual operation and pump wet well down (table 7-6) to lead pump minimum operating elevation (elevation 94.9).

4. Slowly open influent gate (table 6-3) and continue to manually control pump speed until gate is fully open and wet well level stabilized between elevations 95.0 and 95.5.

5. At MCP, select desired raw sewage pump starting sequence and place all RSP mode selectors to AUTO.

6. Check that all automatic station systems are operating properly.

Table 5-5. Electrical Power System — Station Electrical Isolation (Cont.)

COMMENT

This procedure assumes that the influent sluice gate has been closed. Even if left open, however, the procedures are basically the same. After restoring power, place one pump in HAND mode and manually control its speed until wet well level stabilizes near elevation 95.0. If wet well level is very high, a second pump may be needed. When wet well level is stabilized, verify RSP starting sequence and place all pump mode selectors to AUTO. Monitor wet well level at WET WELL LEVEL controller LIC 103K on MCP.

Table 5-6. Simulated Outage

There is no standby generator at the East Marginal Way pumping station. Therefore, no simulated outage procedure is performed. The simulated outage controls and indicators on the station transfer panel anticipate installation of a standby generator sometime in the future. Instead of simulated outage testing, a simulated priority one power failure alarm is transmitted monthly to WPTP via Metrotel (see table 5-3, item 6).

Table 5-7. Mobile Generator Connection

The mobile generator is normally connected and started by maintenance section electricians only. However, operators may sometimes be required to do so. The station must be manned by either an operator or electrician during entire power failure (or generator test) to monitor generator operation and to shut unit down. Load transfer and retransfer are currently done manually pending future installation of an onsite standby generator.

PROCEDURES

Startup and Power Transfer

1. At transfer panel, open (verify) STANDBY GENERATOR and LOAD BANK circuit breakers.

2. On generator, open (verify) output circuit breaker.

3. On MCP, place mode selectors to OFF.

4. Insert generator power cable into 460 V generator receptacle (figure 5-1).

5. Start generator and check voltage and frequency.

6. Close generator output circuit breaker.

7. At transfer panel, rotate TRANSFER SWITCH counterclockwise to EMERGENCY.

8. At transfer panel, close STANDBY GENERATOR circuit breaker.

9. At MCP, activate RSP system in desired mode (see section VII, tables 7-4, 7-5, and 7-6).

10. Check voltage at service panel (upper section).

Power Retransfer and Generator Shutdown

1. At MCP, place all RSP mode selectors to OFF.

2. At transfer panel (lower section), open STANDBY GENERATOR circuit breaker.

3. At transfer panel (upper section), rotate TRANSFER SWITCH clockwise to NORMAL.

4. At MCP, restart RSP system.

5. At generator, open output circuit breaker.

6. After short cooldown period, shut down generator drive engine and disconnect power cable from 460 V receptacle.

Table 5-8. Electrical Power System — Operation of 24-volt Control Power Battery Charger

PROCEDURES

CAUTION

Do not smoke or bring open flame near batteries during charging.

Be careful when using tools or metal objects around battery terminals.

Note

Unless otherwise indicated, all controls and indicators are on battery charger front panel.

Startup and Automatic Operation

1. Check for correct polarity between battery charger and batteries.

2. In CONTROL POWER (ALARM) PANELBOARD B, place circuit breaker 8 to ON.

Table 5-8. Electrical Power System – Operation of 24-volt Control Power Battery Charger (Cont.)

3. Place power on/OFF switch to on position (up). Amber POWER ON indicator comes on. Battery charger ammeter (AMPERES D.C.) indicates a charging current. If the batteries are fully charged, the indication is very slight.

Note

The charger voltmeter (VOLTS D.C.) indicates a nominal 24 volts at all times. The charger automatically maintains this setting.

4. Place FLOAT VOLTAGE selector to NORMAL. If batteries emit gas or use water, rotate selector counterclockwise in small steps until condition is corrected.

Shutdown

1. Place battery charger power on/OFF switch to OFF. Amber POWER ON indicator goes out.

2. Place circuit breaker 8 in CONTROL POWER (ALARM) PANELBOARD B to OFF.

Equalizing Batteries

Batteries should be charged monthly at 1.55 volts per cell to bring all cells to same level.

1. Place EQUALIZE VOLTAGE adjustment selector to NORMAL. Adjust selector to desired voltage as experience and battery manufacturer's data dictate.

2. Rotate EQUALIZING PERIOD timer (0 to 24 hours) clockwise and set for 4 to 6 hours. The timer will automatically time out and return to the FLOAT VOLTAGE setting.

INFLUENT GATE SYSTEM

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SECTION VI
INFLUENT GATE SYSTEM

INTRODUCTION

The influent gate system includes the hydraulically-operated influent sluice gate and the raw sewage pump inlet channel slide gates. The influent sluice gate enables throttling of wastewater flows to the wet well. During abnormal conditions, or for maintenance, the wet well can be isolated by closing the influent gate, and if necessary, by installing the slide gates. If the influent sewer becomes surcharged, the wastewater will rise in the overflow manhole until it flows through the overflow line into the storm drain manhole and then through the storm drain line to the Duwamish River outfall (see figure 1-5).

PHYSICAL DESCRIPTION

The influent sluice gate (figure 6-1) is at the wet well wall where the influent sewer enters. The gate is connected by a stem to a hydraulic operator. Water is supplied under pressure to the hydraulic operator by the C2 water system hydropneumatic tank (see section X). A hand-operated pump on the wet well access stairway landing is used to supply water pressure for gate operation if hydropneumatic tank pressure fails. The float-operated pilot valve in the wet well controls normal automatic gate operation.

Three slide gates are stored in the wet well and are used to block the raw sewage pump inlet conduits, singly or collectively, to either isolate specific pump(s) or to close off the influent channel. Wet well hoisting equipment (see section XII) is used to move gates (see table 6-5). Table 6-1 lists influent gate system equipment characteristics.

FUNCTIONAL DESCRIPTION

The float-operated pilot valve keeps the influent sluice gate open except during abnormally high wet well water level. Normally the bottom of the float is 6 inches below the top of the influent channel and the pilot valve allows water to pass into the lower portion of the gate operator cylinder pushing the operator piston up and keeping the gate open (figure 6-2).

The raw sewage pumping (RSP) system maintains a constant wet well level (see section VII). However, in a situation where the RSP system cannot do so, the wet well water level will rise until, at elevation 100 [influent channel level 7.5 ft. (2.3 m)], the pilot valve float begins to be slowly raised. Simultaneously, a limit switch at the gate triggers alarms (see "Alarm Indications" below). As the float rises, water drains from the lower portion of the gate operator and flows into the upper portion pushing the operator piston (and the gate) downward. Maximum float travel is 6 inches (15 cm) and the gate will modulate within that range to try to stabilize influent channel level without wet well flooding. If the influent channel level rises high enough to fully raise the pilot valve float, the influent sluice gate closes completely. Since the gate is float-controlled, it will reopen automatically as the wet well level drops. If the float sticks, the gate must be reopened manually (see table 6-3).

Note

C2 water system hydropneumatic pressure is critical to influent sluice gate operation. If the gate does not operate or malfunctions, check hydropneumatic tank pressure (table 10-5) specifically, and the C2 water (section X) and service air (section VIII) systems, generally. See "COMMENTS" in table 6-3.

ALARM INDICATIONS

There is one alarm associated with the influent gate system. If the influent gate starts to close, a limit switch on the gate closes and sends alarms to CATAD and to WPTP via Metrotel.

High influent channel levels trigger alarms through float switches FS 115 and FS 115B. See section VII for further information.

OPERATOR SERVICES

Operator services for the influent gate system are described in table 6-2. An illustration at the end of the table shows where each check or service is performed.

OPERATING PROCEDURES

In normal operation, the influent gate is fully open, but will modulate or close automatically as the influent channel level rises past certain setpoints. Maintenance or emergencies may require manual changes of influent sluice gate opening or the placement/removal of slide gates in the pump inlet channels.

Influent sluice gate system operating procedures are presented in tables 6-3 through 6-6. Wet well and influent channel hosedown (table 6-5) is a preventive maintenance operation to insure that the influent sluice gate and slide gate guides do not become encrusted and hinder proper operation. The pump inlet channel and effluent junction structure slide gates are used to isolate specific pumps and close off certain channels or wet areas.

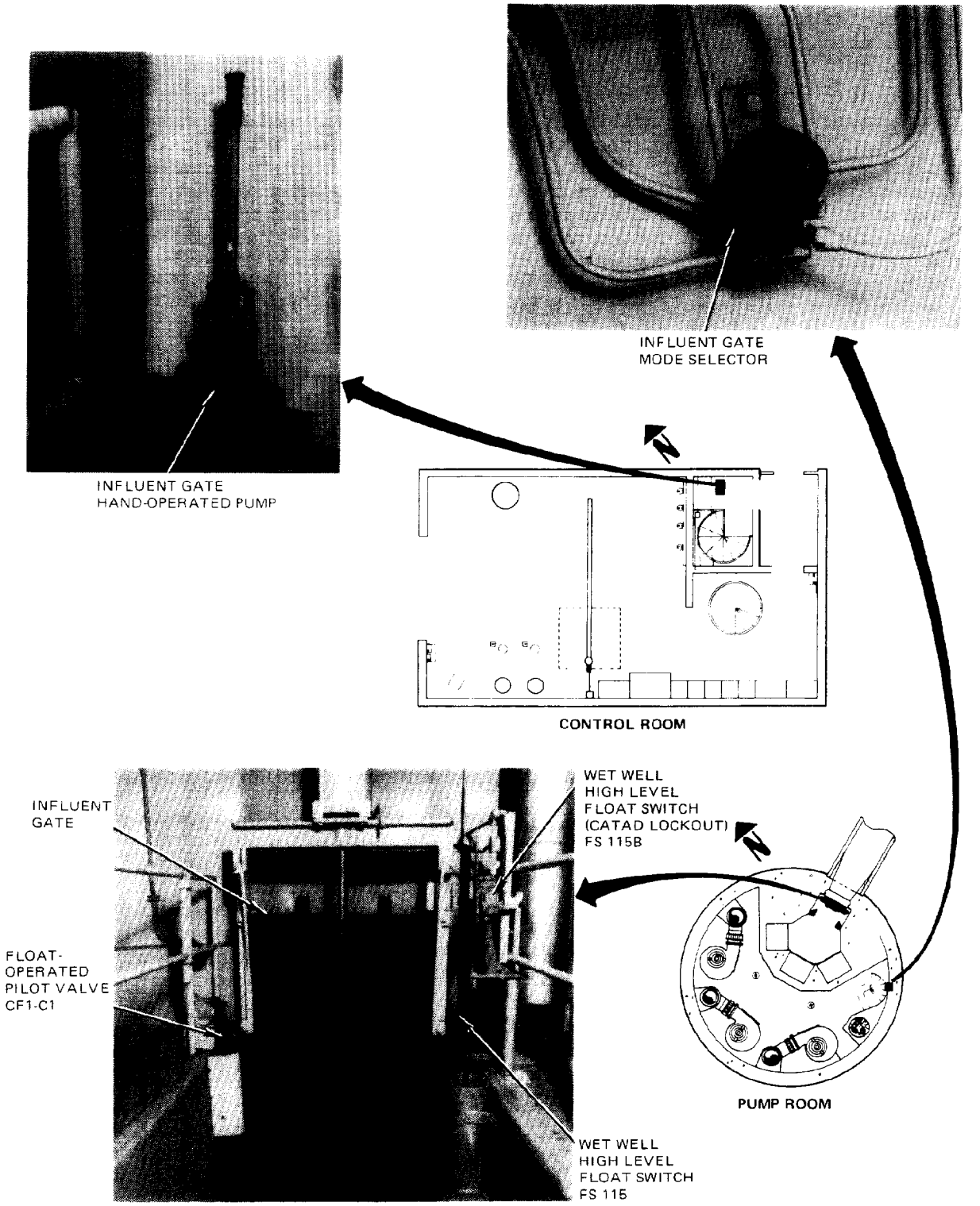

Figure 6-1. Influent Gate System Equipment

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Table 6-1. Influent Gate System Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
Influent Sluice Gate		Armco Drainage & Metal Products Inc., model 55-20; size – 42- by 60-in. (107- by 152-cm) cast iron
Gate Operator		Hydro-Line Mfg Co., model R2G; stroke length – 60 in. (152 cm); operating water pressure – 150 psi (10.5 kg/sq cm)
Hand-operated Pump		William S. Pine Inc., series No. 2000, catalog No. 2000-12; piston diameter – 1-1/2 in. (3.8 cm)
Four-way Operating Valve		Cla-Val Co., Forway valve No. 110, drawing No. 32413; maximum pressure rating – 300 psi (21.1 kg/sq cm)
Mode Selector		Cla-Val Co., model C-5018; selector positions – AUTO/LOCK/ CLOSE
Float-Controlled Pilot Valve		Cla-Val Co., model CFI-C1 operation – hydraulic
Limit Switch		Square D Company, class 9007, type BR5382
Wet Well High Level Float Switch* (CATAD Lockout)	FS 115B	Square D Company, class 9035, type DR3, form 25, series B
Wet Well High Level Float Switch*	FS 115	Allen Bradley Company, style A, type 7, class 1, group D, catalog No. 840-A7, series A
*Also listed in table 7-1		

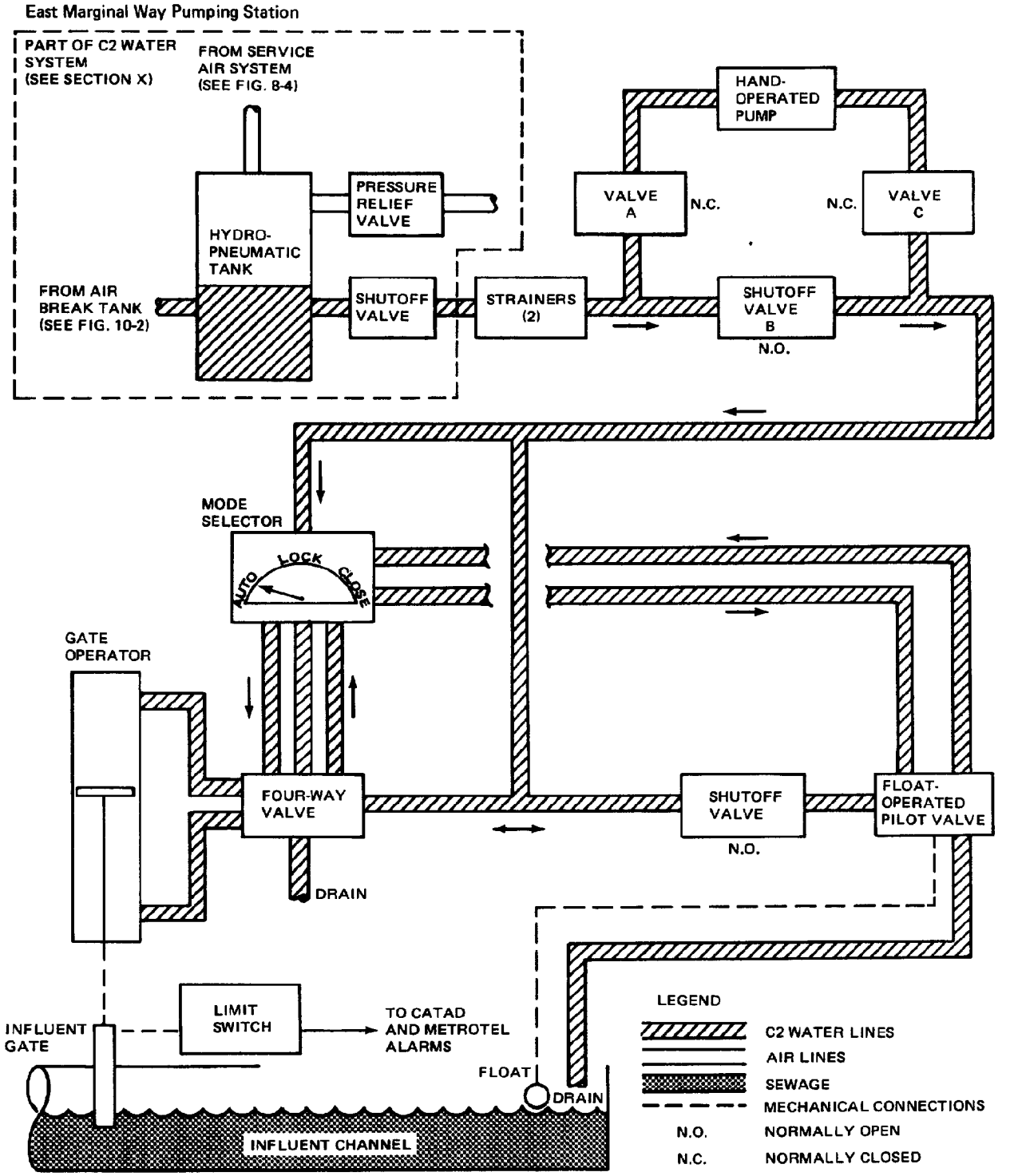
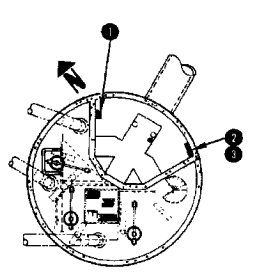


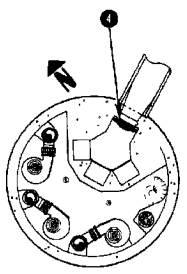
Figure 6-2. Influent Gate System Functional Diagram

Table 6-2. Influent Gate System Operator Services

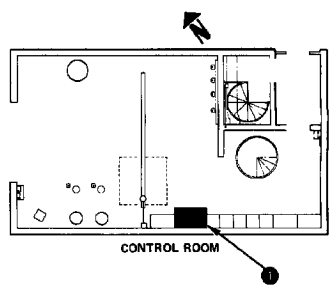
ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
WEEKLY			
1. Lower influent channel level (table 7-6) and hose down side walls (table 6-4).	Note *Raw sewage pump(s) will shut down automatically when wet well low level alarm setpoint (elevation 94,0) is reached. Pumps restart when wet well level rises to elevation 94,9. Return raw sewage pump(s) to normal operating mode (table 7-7) when hosedown is completed.*		
QUARTERLY			
2. Close influent sluice gate 20% to check for free operation.	2. Gaskets and components in good operating condition.	2. Other than specified.	2. Clean and grease gate stem whenever operation is difficult or grease has hardened.
SEMI-ANNUALLY			
CAUTION *Do not leave influent sluice gate closed for more than a few minutes. See COMMENTS in table 6-3.*			
3. Close influent sluice gate completely (table 6-3), check for free operation and proper seating.	3. Gate operates smoothly and seats properly.	3. Gate operation difficult and/ or excessive leaking at seating faces.	3. See step 4.
4. Clean all sliding surfaces and lubricate with anti-seize compound.	– – –	– – –	– – –



MOTOR ROOM AND WET WELL



PUMP ROOM



CONTROL ROOM

East Marginal Way Pumping Station

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Table 6-3. Influent Sluice Gate Operation

PROCEDURE

Manual Operation (From Mode Selector Behind Wet Well Access Stairway)

1. To close gate, place mode selector to CLOSE.

2. To raise gate, place mode selector to AUTO.

Note

When the mode selector is in AUTO, the influent gate is controlled by the float-operated pilot valve. When the pilot valve float is fully extended (down), the influent gate should be fully open.

3. To lock gate in position, place mode selector to LOCK.

COMMENTS

The influent sluice gate may also be closed or opened by manual operation of the pilot valve float. The mode selector must still be placed to LOCK to hold gate in position.

Continuous gate travel time, from fully closed to fully open, is about 7 minutes.

If the gate has been closed for more than a few minutes, open it slowly to match influent flow with raw sewage pumping and prevent wet well flooding. This may take 1-1/2 to 3 hours depending on weather conditions and how long the gate has been closed.

Operation without C2 Water Pressure

Note

Refer to figure 6-2. Valves are behind wet well exhaust duct and accessible from wet well stairway.

1. Place mode selector behind wet well stairway to AUTO to raise gate, or to CLOSE to lower gate.

2. Close C2 water supply valve B and open pump isolation valves A and C.

3. On wet well access stairway landing, operate hand pump until desired gate position is reached.

4. Place mode selector to LOCK.

5. When C2 water pressure has been restored, close valves A and C, open valve B, and place mode selector to AUTO.

Table 6-4. Wet Well and Influent Channel Hosedown

PROCEDURE

1. Lower influent channel level (table 7-6).

WARNING

Use two operators when working around open channels and handling floor gratings. Uncover channels one at a time. Set up safety barriers as necessary, and wear safety harnesses to descend into channels.

2. In wet well, lift floor grating sections to uncover influent and raw sewage pump inlet channels.

3. Hose down side walls and other exposed channel areas. Remove all debris.

4. Replace floor grating sections when finished.

5. Return raw sewage pump(s) to automatic operation (table 7-7).

Table 6-5. Pump Inlet Channel Slide Gate Installation and Removal

PROCEDURE

Installation

1. Shut down and isolate raw sewage pump(s) supplied by inlet channel(s) to be gated (tables 7-10 and 7-11).

CAUTION

Do not close influent gate completely. Monitor RSP operation to avoid cavitation.

2. Close influent gate until influent channel turbulence and velocity moderate.

WARNING

Two operators are required when handling floor gratings, gates, or chain hoists. Wear safety harness when working around open wet well.

3. In wet well, remove floor grating from above guides of channel to be gated; place grating away from area of operations to avoid safety hazards.

4. Lift gate from storage hooks, and lower gate into guides slowly to avoid misalignment and binding.

5. Replace floor grating.

Removal

1. Perform step 2 above.

2. Remove respective floor grating(s). See step 3 above.

3. Slowly lift gate from guides and replace on storage hooks.

4. Replace floor grating(s).

COMMENT

The accumulation of sewage debris, such as grit, around the installed slide gate, especially in the guides, may prevent or seriously impair removal. To overcome that problem, the following procedures are suggested in order of application:

1. Close influent sluice gate (table 6-3).

2. Pump down wet well (table 7-9).

3. Flush influent channel, especially around slide gate guides (table 6-5).

4. Install overhead chain hoist and raise slide gate.

Table 6-6. Effluent Junction Structure Slide Gate Installation and Removal

PROCEDURE

1. Obtain effluent junction structure slide gates from Duwamish pumping station.

2. Using appropriate mobile lifting device, remove lift slab(s) from over junction structure slide gate guides (see figure 1-1). Place slabs out of way for safety.

3. Using same lifting devices, lower gate(s) into position. Lower slowly to avoid binding and misalignment.

4. Replace lift slab(s).

5. To remove slide gates, reverse procedure.

RAW SEWAGE
PUMPING SYSTEM

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SECTION VII
RAW SEWAGE PUMPING SYSTEM

INTRODUCTION

The raw sewage pumping (RSP) system consists of three pumping units and ancillary equipment as shown in figure 7-1. The variable speed pumps automatically respond to changes in wet well level, drawing wastewater from the influent channel and discharging it through 24-inch (61-cm) force mains into the effluent junction structure (see section I for related information). Major system equipment characteristics are listed in table 7-1.

PHYSICAL DESCRIPTION

Each raw sewage pumping unit consists of a pump and electric drive motor connected by a speed-adjusting coupling. Each pump intake connects to the wet well through a suction conduit that reduces from 36 inches (91 cm) at the wet well to 24 inches (61 cm) at the pump (see figure 1-4).

Station 460-volt power is supplied to the pump drive motors through MCC motor controllers B3, C3, and D3. The eddy-current coupling controllers are in MCC section E (see figure 4-1). Each pumping unit has a pump shaft vibration monitor and drive motor high temperature sensor that effect automatic shutdown if parameter limits are exceeded (table 7-2).

FUNCTIONAL DESCRIPTION

General

The RSP system enables the following:

- Independent maximum speed adjustment for each unit;
- Change of pumping unit speed proportional to variations in wet well level;
- Two independent wet well level control modes (CATAD or station bubbler, see section IV);
- Independent selection of any one of the units for standby operation; and
- A separate feedback speed control loop for each pumping unit.

The system normally operates automatically, being controlled through CATAD or the station wet well level (bubbler) control circuit (figure 7-2). Pump speed and the number of units operating is increased or decreased to maintain a preset wet well level setpoint (established by CATAD; or under local automatic control, set on WET WELL LEVEL controller-transmitter LIC 103K). The pumping unit drive motors are constant-speed types and pump speed is varied by increasing or decreasing the speed of the eddy-current coupling output shaft (see figure 7-2). Each pumping unit discharges into its own force main which terminates at the effluent junction structure (see figure 1-5). The pumps lift the wastewater 16 feet (4.9 m) from the bottom of the wet well influent channel to the force main invert elevation.

During pump operation water from the C2HP subsystem (section X) flows through the seal water manifold (strainer, solenoid control valve, and rotameter) to the pump stuffing box mechanical seal. The water lubricates the seal, prevents leakage through the pump bearing, keeps air from being sucked in at the seal, and flushes out abrasive material. A bypass line supplies water to the stuffing box during maintenance of the manifold components.

Control and Monitoring

Control Selector. The station CONTROL SELECTOR on the MCP determines whether the RSP system is controlled from the CATAD central console or by the local wet well level control (bubbler) network. The selector controls three-way solenoid valve SV 103C which selects what wet well level control signal shall pass to WET WELL LEVEL controller LIC 103K. In CATAD position, level comparison contact controller LCC 103F compares the output of wet well level transmitter LT 103A to the CATAD-established setpoint on setpoint manual controller MC 103G. In LOCAL position, the CATAD system is locked out and the output of LT 103A is compared to the wet well level setpoint preset into LIC 103K. In either case, a pneumatic signal representing the difference between actual wet well level and a setpoint results and passes through the solenoid valve to LIC 103K.

Pump Program. Instrument loop IL 103 controls the speed of selected raw sewage pumps to maintain a constant wet well level according to the pump program (figure 7-3). Wet well level transmitter LT 103A monitors wet well level through a bubbler network and transmits a pneumatic signal proportional to the level to WET WELL LEVEL recorder LR 103J, to the CATAD control console through the TCU, and to the station CONTROL SELECTOR solenoid valve which selects the appropriate wet well level control signal as described above in "Control Selector."

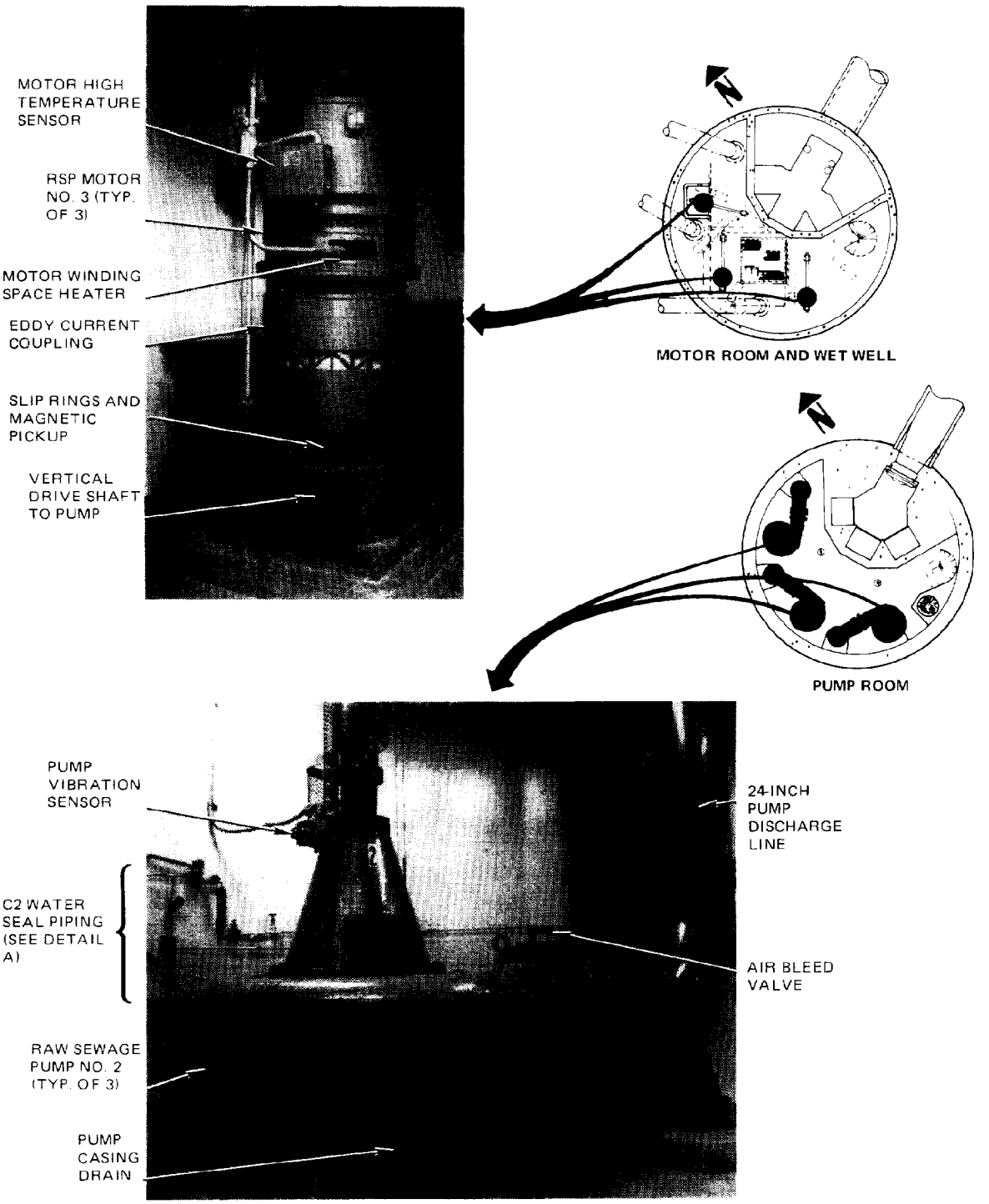


Figure 7 1. Raw Sewage Pumping System Equipment (Sheet 1 of 5)

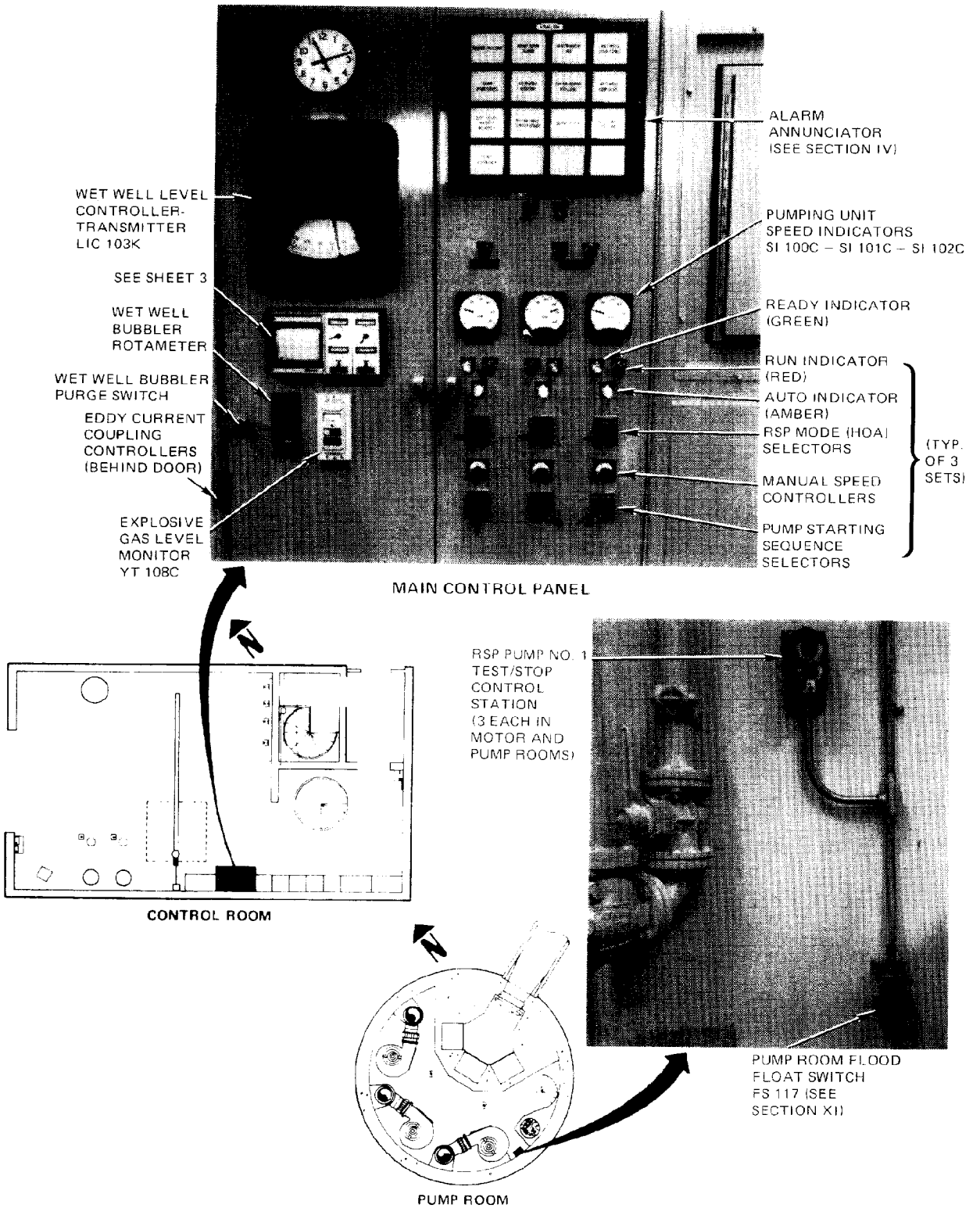
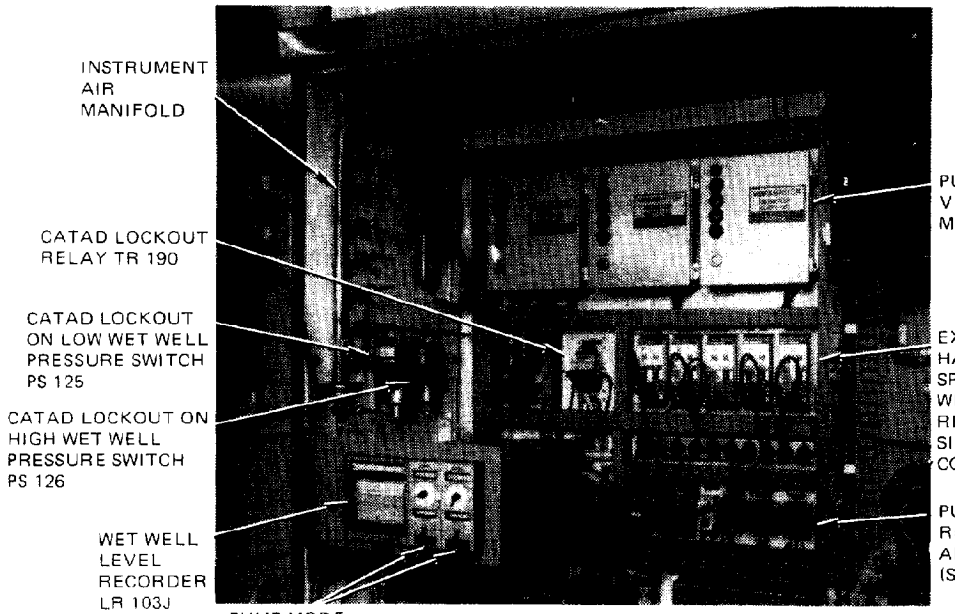
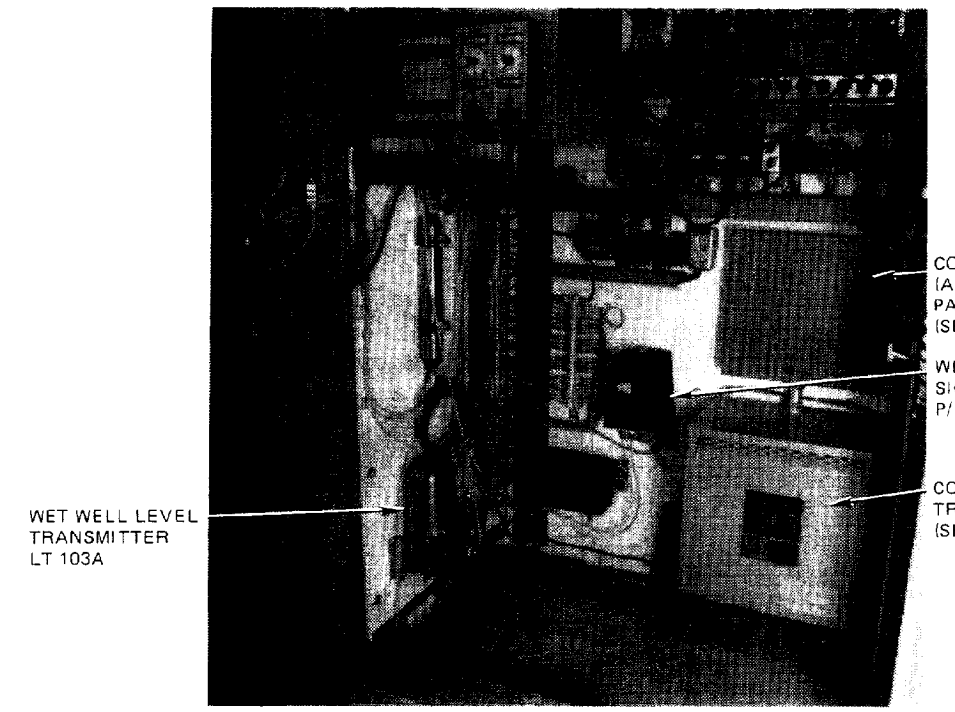


Figure 7-1. Raw Sewage Pumping System Equipment (Sheet 2 of 5)



INSIDE MCP – UPPER



INSIDE MCP – LOWER

Figure 7-1. Raw Sewage Pumping System Equipment (Sheet 3 of 5)

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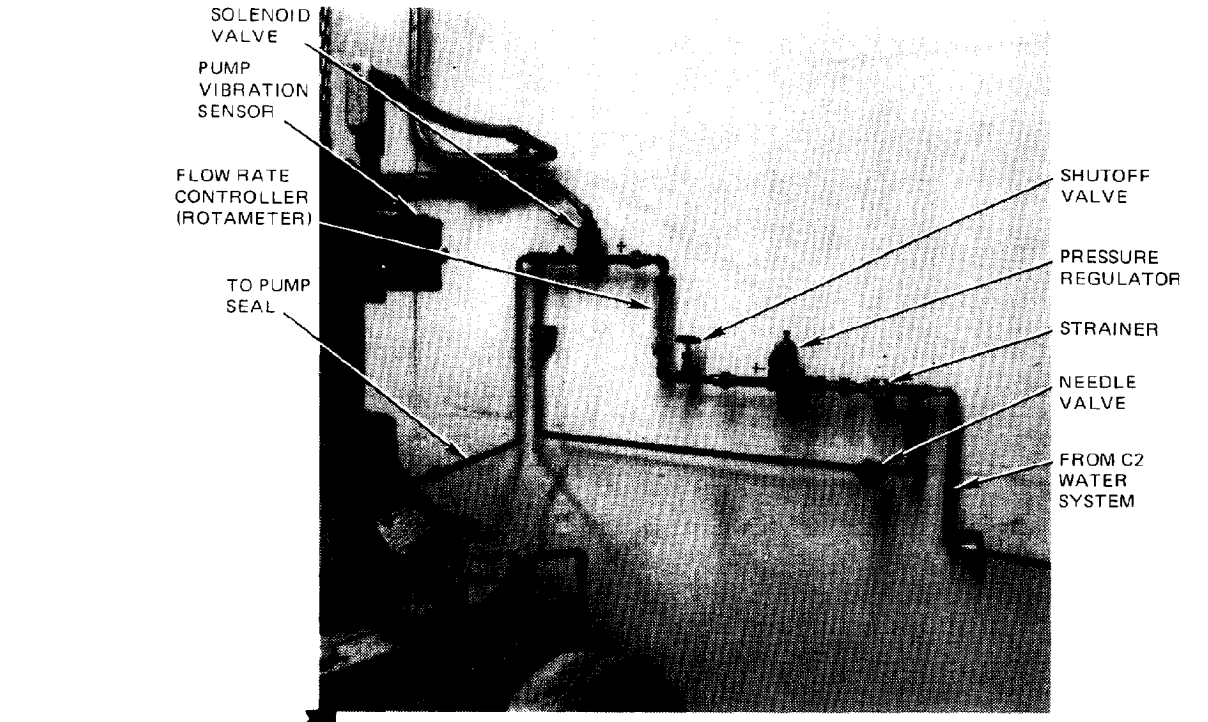
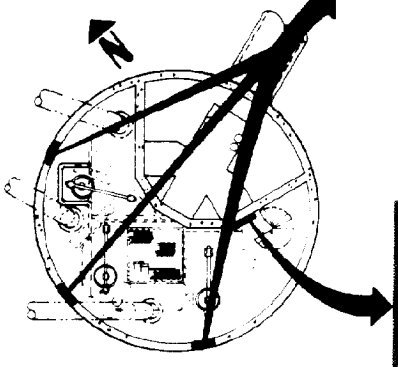
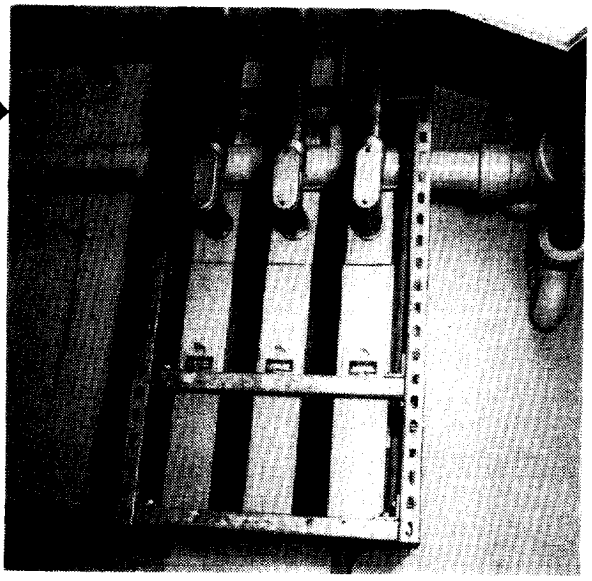


DETAIL A
C2 WATER SEAL PIPING (TYP. OF 3)



MOTOR ROOM AND WET WELL



RSP MOTOR CAPACITORS

Figure 7-1. Raw Sewage Pumping System Equipment (Sheet 4 of 5)

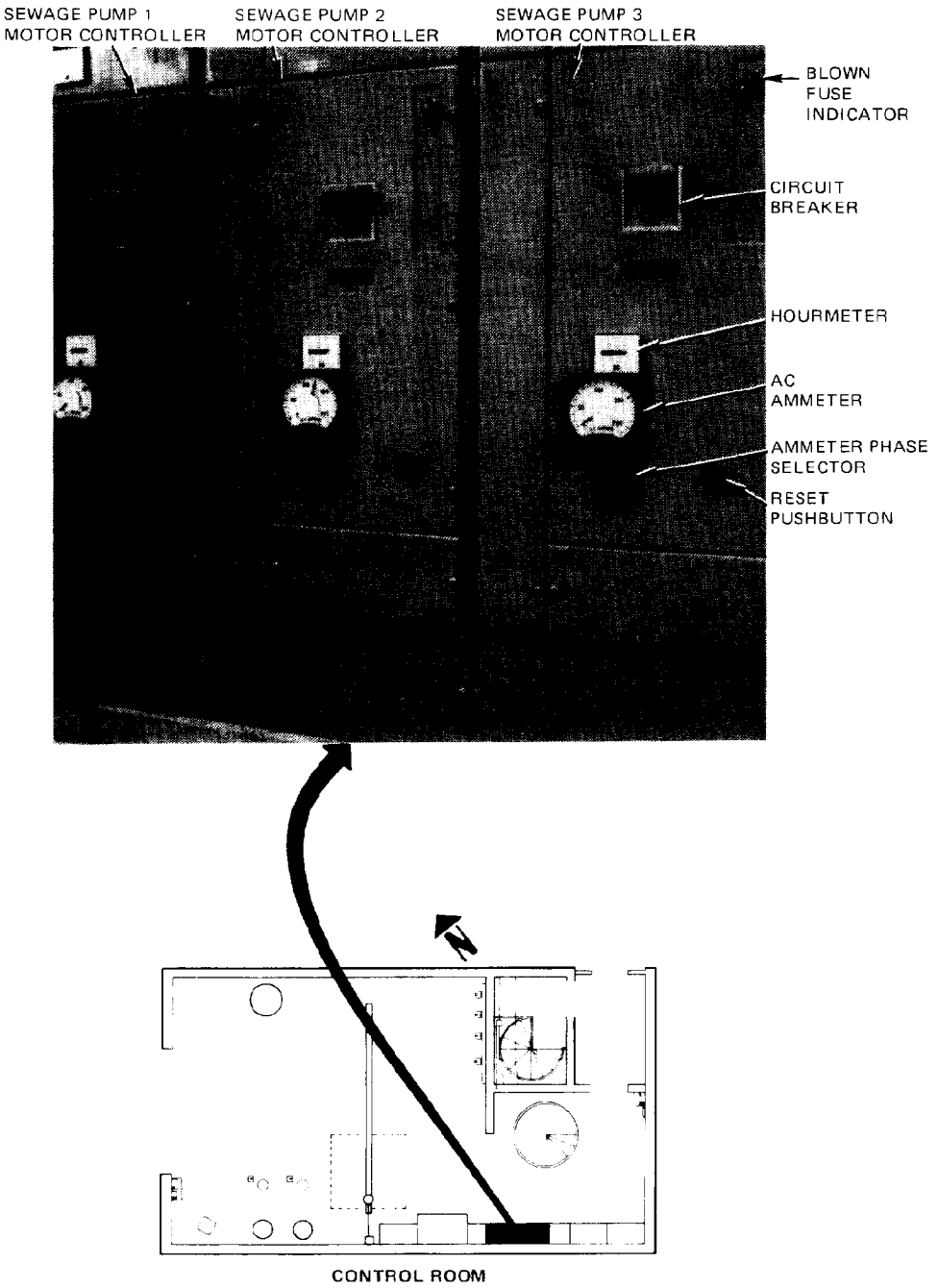


Figure 7-1. Raw Sewage Pumping System Equipment (Sheet 5 of 5)

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Table 7-1. RSP System Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
Raw Sewage Pumping Units (3):		
Pumps (3)	P 100 P 101	Worthington Pump International, Inc. Model 24MCZ1; capacity – 1 mgd (3,785 cu m/day) at 350 rpm and 16.5 ft (5 m) total dynamic head (TDH)
	P 102	Worthington Model 24MNZ; capacity – 23 mgd (87,055 cu m/day) at 455 rpm and 125 ft (38 m) TDH
Drive Motors (3)	M 100 M 101 M 102	General Electric Corporation Model 5K6325XC253A; rating – 100 hp (74.6 kw) at 500 rpm; 60 Hz, 3-phase, 460 V
Variable Speed Couplings (3)		Electric Machinery (E-M) Manufacturing Company Division of Turbodyne Corporation Ampli-Speed magnetic (eddy-current) drive with MDS 20 frame; input speed – 505 rpm
Motor High Temperature Sensors (3)		Motogard Series 115 with PTC 600 thermistor; with alarm and motor shutdown setpoints
RSP SPEED CONTROL INSTRUMENT LOOP:	IL 100 IL 101 IL 102	
Variable Speed Coupling Controllers (3)		E-M type TCRS-16, Model S-2016 static speed controller, Part Number 386A054G02; ac input – 230 V, single-phase; dc output – 190 V
Speed Transmitters (3)	ST 100A ST 101A ST 102A	E-M Part Number 139A326F01; includes cable assembly Part Number 139A326F02
Speed Signal Converters (3)	E/I 100B E/I 101B E/I 102B	Moore Industries Model SCT/0-5 V/10 to 50 mA/117 Vac/STD voltage-to-current signal converter; input signal – 0 to 5 Vdc; output signal – 10 to 50 mA dc
Speed Indicators (3)	SI 100C SI 101C SI 102C	Westinghouse Electric Corporation Model 10312, type 5119L SI 100C; input signal – 10 to 50 mA dc; scale range – 0 to 500 rpm
WET WELL LEVEL CONTROL INSTRUMENT LOOP:	IL 103	
Wet Well Level Transmitter	LT 103A	The Foxboro Company Model 13A1-MK2 differential pressure transmitter; input range – 0 to 10 ft (3 m); output signal – 3 to 15 psi (0.2 to 1.1 kg/sq cm)
Wet Well Level Signal Converter	P/I 103B	Fischer and Porter Company input signal – 3 to 15 psi; output signal – 4 to 20 mA
CATAD/LOCAL (Station) Solenoid Valve	SV 103C	Skinner Electric Valve Division Model V56DA2100 3-way, directional solenoid valve; 1/4-FPT with 1/8-in. (3.2 mm) and 3/32-in. (2.4 mm) ports; rating – 120 Vac continuous

Table 7-1. RSP System Equipment Characteristics (Cont.)

COMPONENT	METRO NUMBER	CHARACTERISTICS
Computer (CATAD) Control Signal Converter	I/P 103D	Fischer and Porter Company; input signal – 4 to 20 mA dc; output signal – 3 to 15 psi
Wet Well Level Current-to-Current Repeater	I/I 103E I/I 103H	Fischer and Porter Company Model 50EK10000; input/output signals – 5 to 20 mA
Level Comparison Contact Controller	LCC 103F	Fischer and Porter Company electronic difference alarm controller; input signals (2) – 4 to 20 mA dc; output signal – 4 to 20 mA dc
Setpoint Manual Controller	MC 103G	Fischer and Porter Company
Wet Well Level Recorder	LR 103J	The Foxboro Company Model 6410HR-0 single-pen electronic Consotrol recorder with 30-day roll chart; input signal – 10 to 50 mA dc; scale – 92.0 to 102.0 ft (28 to 31 m); chart speed – 0.75-in. (1.9 cm)/hr
Wet Well Level Controller Transmitter	LIC 103K	The Foxboro Company Model 40NPC315-75 pneumatic receiver with type 70 contact electric controller; scale range – 0 to 10 ft (3 m), calibrated for 92.0 to 102.0 ft; input signal – 3 to 15 psi; output signal – 10 to 50 mA dc proportional to input
Lead/Follow Pump Mode Controllers (2)	LC 103L LC 103M	The Foxboro Company Model 62H-2E-OH-L proportional plus reset single-mode electronic controller with 5 to 300% proportional; input/output signals – 10 to 50 mA dc
Coupling Controller Signal Isolating Converters (3)	I/E 103N I/E 103P I/E 103Q	Rochester Instrument Systems, Inc. Model SC-1302-6442 isolated signal transmitter (current-to-voltage signal converter); input signal – 10 to 50 mA dc, output signal – 0 to 6.2 Vdc
Wet Well Level Recorder Input Signal Converter	I/I 103R	Moore Industries Model SCT/4-20 mA/10 to 50 mA/117 Vac/STD current-to-current signal converter-transmitter; input signal – 4 to 20 mA, output signal – 10 to 50 mA
Pressure-to-Current Converter	P/I 103S	The Foxboro Company Model E92-FFN2H air-to-current converter; input signal – 3 to 15 psi; output signal – 10 to 50 mA dc
Instrument Loop Power Supply	PS 103T	Acopian Technical Company Model B80GT10 regulated power supply; input – 120 Vac, output – 80 Vdc
RSP VIBRATION ALARM CIRCUITS (3):		
Vibration Sensors (3)	VX 118 VX 119 VX 120	Robertshaw Controls Company Vibraswitch Model 365-A7-S malfunction detector; vibration measurement range – 0 to 300 Hz
Vibration Monitors (3)	VS 118 VS 119 VS 120	Robertshaw Controls Company Vibraswitch Model 561-W-1-R electronic monitor unit; adjustable monitoring time delay – 2 to 30 seconds; starting time delay – 5 to 240 seconds

Table 7-1. RSP System Equipment Characteristics (Cont.)

COMPONENT	METRO NUMBER	CHARACTERISTICS
RSP SEAL WATER MANIFOLDS (3):		
Solenoid Valves (3)	SV 109 (RSP #3)	Automatic Switch Company Catalog Number F18211D2; pressure range – 5 to 200 psi (0.35 to 14 kg/sq cm); 120 Vac
	SV 107 (RSP #1) SV 108 (RSP #2)	Automatic Switch Company Catalog Number 8223A21; pressure range – 10 to 750 psi (0.7 to 53 kg/sq cm); 120 Vac
Rotameter/Regulator Units (3)		Brooks Series 8800 Sho-Rate 50 Model 1350 purge meter with integral differential pressure regulator and tube 2-65A; scale – 0 to 2 gpm (7.6 lpm)
WET WELL BUBBLER IA SUPPLY:		
Rotameter/Regulator		Fischer and Porter Company Model 10A3135N purge meter with integral differential pressure regulator; capacity – 1.9 scfh (0.05 cu m/hr); scale – 0 to 100%
Purge Switch		King Engineering Company Part Number 6930 four-part purge air switch; maximum applied air pressure – 20 psi (1.4 kg/sq cm)
Wet Well High Level Float Switch (Alarm)*	FS 115	Allen-Bradley Company, style A, type 7, class 1, group D, Catalog Number 840-A7, series A
Wet Well High Level Float Switch (Standby pump start)*	FS 115B	Square D Company, class 9035, type DR-3, form Z5
CATAD Lockout Pressure Switches (2)	PS 125 (wet well low level) PS 126 (wet well high level)	Square D Company, class 9012, ACW-4, single-pole, double-throw pressure differential snap switch; input pressure – 3 to 15 psi

*Also listed in table 6-1.

Whatever the source of the wet well level control signal, WET WELL LEVEL controller LIC 103K converts it to a milliampere signal that is transmitted to either pump mode controller LC 103L or LC 103M. LC 103L is essentially the lead pump on-off switch; it permits lead pump operation as long as wet well level is above elevation 94.0. (Below elevation 94.0, all pumps are locked out). Between elevations 94.0+ and 96.2, the output of LIC 103K is transmitted through LC 103L to the lead pump eddy-current coupling controller, which in turn controls the output speed of the pump eddy-current coupling (and the pump). At elevation 96.2, the LIC 103K output signal is routed through pump mode controller LC 103M, starting the follow pump, to the lead and follow pump eddy-current coupling controllers. At elevation 98.5, wet well level float switch FS 115B starts the standby pump independently of the wet well level control circuit. The pump accelerates to and maintains a preset speed until wet well level drops to elevation 96.5. WET WELL HIGH LEVEL alarm AL 4 is triggered and cancels with standby pump operation. On falling wet well level, the follow pump shuts down at elevation 95.4; the lead pump at elevation 94.4. Wet well level below elevation 94.0 locks out all pumps and triggers WET WELL LOW LEVEL alarm AL 8 until level rises to elevation 94.5. If the station is under CATAD control, CATAD lockout is also triggered at elevations 94.0 (low wet well) and 98.5 (high wet well) and the RSP system automtically switches to local wet well level control. CATAD lockout, however, does not cancel automatically with rising wet well level. CATAD control must be manually restored by pressing the CATAD LOCKOUT RESET pushbutton on the MCP (see section II).

Raw Sewage Pump Controls. The pumping unit mode selectors on the MCP enable three operational modes: HAND, AUTO, or PUMP DowN. The normal mode is AUTO, permitting automatic pump on-off cycling and speed control in response to signals from WET WELL LEVEL controller LIC 103K. In HAND mode, the individual pump speed is controlled by its manual speed controller (speed adjust) on the MCP. In this mode, a pump runs continuously at the selected speed until the WET WELL LOW LEVEL alarm and pump lockout elevation is reached, or the mode selector is placed to AUTO or OFF. In PUMP DowN, the low level alarm and pump lockout circuits are bypassed and care must be taken not to permit wet well level to fall below the pump inlets (elevation 92.9) and cause pump cavitation. The PUMP DowN position is spring loaded to return to AUTO, and must be held in place when pumping down the wet well. The pumping unit duty, or starting sequence selectors, determine the starting sequence of each unit. A pump may be selected for any one of the three starting positions (LEAD, FOLLOW, STANDBY). The pump selected as standby unit, however, is started by high wet well float switch FS 115B independently of the wet well level control circuit and accelerates automatically to a preset speed (see "Pump Program").

Pumping Unit Alarms. In addition to the RSP system alarms (wet well high and low levels, CATAD lockout), each raw sewage pumping unit has sensors to monitor pump shaft vibration and motor temperature. If drive motor temperature exceeds ^{o}F (^{o}C), alarm AL 10 (MOTOR HIGH TEMPERATURE) is triggered at the MCP annunciator; at ^{o}F (^{o}C), the unit automatically shuts down. Excessive pump shaft vibration also shuts the unit down and triggers local alarm AL 13 (PUMP VIBRATION). The vibration monitor may be reset (TBS) times before pump shutdown is permanent. In either alarm situation, pumping unit shutdown alerts CATAD of equipment shutdown through the TCU PUR relays (TCU contact 8, 9 or 10) and by loss of analog pump speed indication. Refer to section IV, figure 4-2 and to table 7-2 for additional information.

ALARM INDICATIONS

Table 7-2 lists the alarms monitored on the main control panel annunciator and the indication provided at WPTP's outlying-facilities alarm annunciator panel. The table includes the sensor or control relay associated with the indication, the point at which the alarm indication occurs, and corrective action. A digital recorder on the operation supervisor's desk in the WPTP main control room prints out alarms from the pumping station; it records the time and date the alarm is received, and when the alarm is cleared. A similar recorder keeps a continuous printout at CATAD central control.

OPERATOR SERVICES

Periodic operator-performed RSP system services and checks are listed in table 7-3. An illustration at the end of the table shows where each check or service is made.

OPERATING PROCEDURES

The RSP system normally operates automatically to maintain wet well level between elevations 95.0 and 95.5. Remote signals, responding to wet well influent flow variations, control pump starting and stopping, starting sequence, and speed. Tables 7-4 through 7-11 provide system operating procedures.

The following procedures are intended to establish standard system operating methods, but do not preclude using valid alternates. If an alternate procedure is easier, more efficient, or preferable, or if procedures change, notify the Metro Technical Publications Supervisor so that revisions can be incorporated into the manual.

Note

Unless indicated otherwise, all controls and indicators are on front of main control panel (MCP).

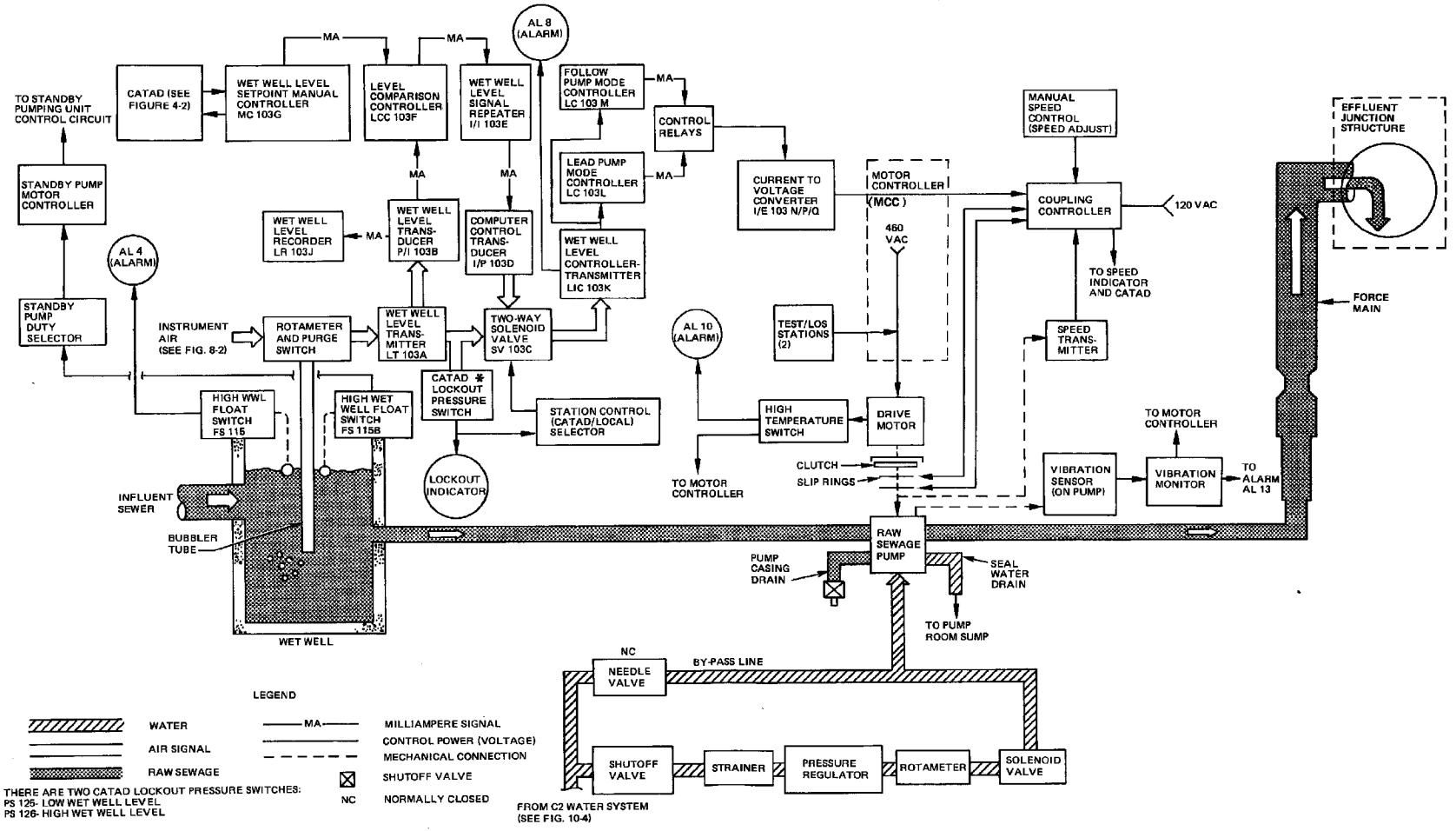


Figure 7-2. Raw Sewage Pumping System Simplified Diagram

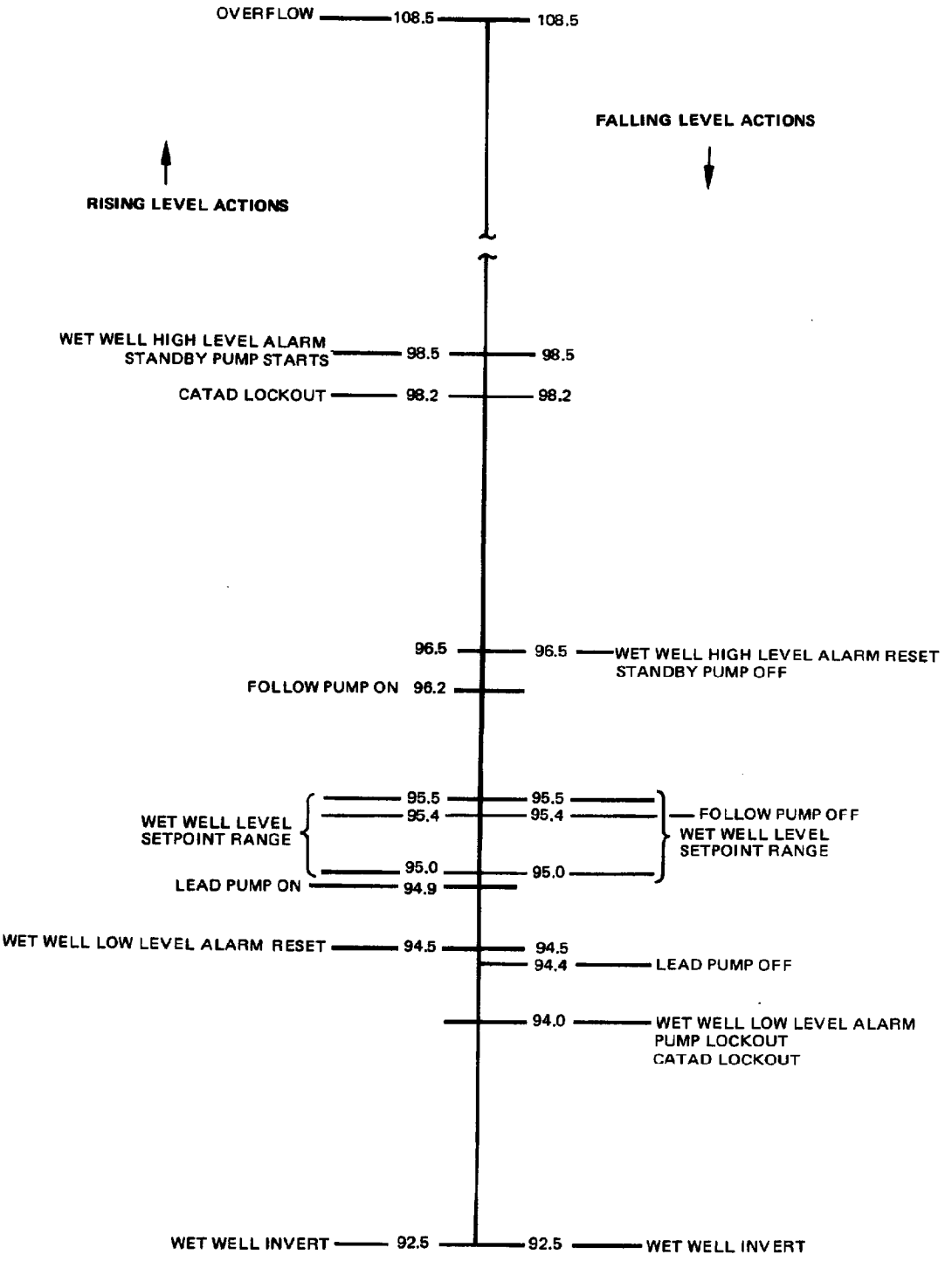


Figure 7-3. Wet Well Level Program

Table 7-2. Raw Sewage Pumping System Alarm Indications

ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
			Note *Record all actions in station log.*
AT MCP ANNUNCIATOR:			
WET WELL HIGH LEVEL (AL 4)	Float Switch FS 115	Wet well level at elevation 98.5 (rising)	CATAD is locked out and RSP system is under local automatic control. All three pumps should be running. (Float switch FS 115B has automatically started standby pump.) If all three pumps are running, check for blocked intakes or discharge lines, clogged impellers, etc., and notify supervisor. If one or more pumps is not running, check for open motor controller circuit breaker, thermal overload, blown control circuit fuse (on motor controller), etc. Alarm clears when wet well level falls to elevation 96.5. Press CATAD LOCKOUT RESET pushbutton to restore CATAD control.
WET WELL LOW LEVEL (AL 8)	Contact on WET WELL LEVEL controller LIC 103K	Wet well level elevation 94.0 (falling)	CATAD is locked out and all RSP system is under local automatic control. All three pumps should have automatically shut down. If any is still operating, immediately shut down manually (table 7-10) to prevent cavitation. Allow wet well level to rise past elevation 94.5 to clear alarm and energize pump control circuits. Press CATAD LOCKOUT RESET pushbutton to restore CATAD control. If lead pump starts below elevation 94.9 or operates below elevation 94.0, switch to manual control (table 7-6) and notify supervisor.
CATAD LOCKOUT	Pressure switch PS 126 (high wet well) Pressure switch PS 125 (low wet well)	Elevation 98.5 (rising) Elevation 94.0 (falling)	CATAD is locked out and RSP system is under local automatic control. When wet well level has returned to normal, press CATAD LOCKOUT RESET pushbutton to restore CATAD control. If malfunction continues, place TCU CONTROL selector to LOCAL and notify supervisor. When malfunction has been corrected, place TCU CONTROL selector to REMOTE and press CATAD LOCKOUT RESET pushbutton on MCP to restore CATAD control; and press alarm RESET pushbutton to clear annunciator.
PUMP VIBRATION (AL 13)	Vibration sensors VS 118, VS 119, VS 120	(To be supplied)	Pump automatically shuts down. At vibration sensor (on pump) and at vibration monitor (inside MCP) press RESET pushbutton to reset alarm and pump control circuits; restart pump. Circuits may be reset (TBS) times before shut down is permanent. If unit shuts down again, isolate electrically (table 7-10/11); assure that remaining units are placed in lead and follow positions (table 7-8); and, in any event, notify supervisor.
MOTOR HIGH TEMPERATURE (AL 10)	Temp. sensor on RSP drive motor	Alarm—(TBS) Shutdown—(TBS)	Notify supervisor.

Table 7-3. Raw Sewage Pumping System Operator Services

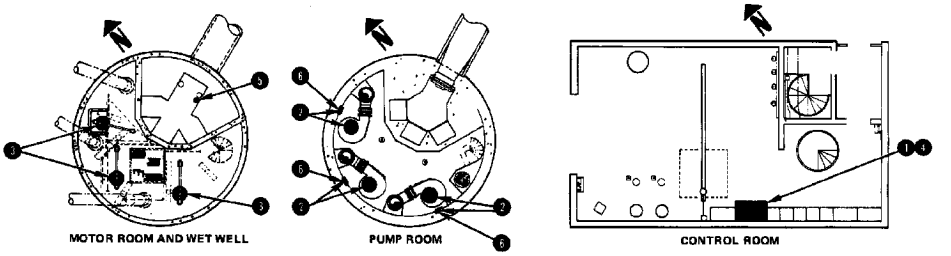
ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY:			
1. At main control panel:			
1a. Check position of station CONTROL SELECTOR. If to LOCAL, go to step 1b. If to CATAD, place selector to LOCAL and wait 15 seconds for bubbler system to stabilize before proceeding. **Note** *Wet well level reading can be taken only if CONTROL SELECTOR is placed to LOCAL.*	– – –	– – –	– – – **Note** *Log all actions in station log.*
1b. On WET WELL LEVEL controller LIC 103K, check wet well level.	1b. Between elevations 95.0 and 98.2 ft (29.0 and 30.0 m).	1b. Other than normal.	1b. Check station log and WET WELL LEVEL recorder for possible explanation. Purge wet wet well bubbler tube. If necessary check and adjust rotameter air flow rate (item 1d).
1c. Purge wet well bubbler tube.	– – –	– – –	– – –
1d. Check wet well rotameter air flow rate. Read at float ball center.	1d. 0.8 scfh (0.023 cu m/hr).	1d. Other than normal.	1d. Adjust rotameter needle valve as required. If unable to adjust, check operation of instrument air system.
1e. Check WET WELL LEVEL recorder LR 103J trace.	1e. Continuous sharp trace since last observation or maintenance with no sudden or erratic deviations. Trace and WET WELL LEVEL controller reading concur at design elevation. Nearly straight line over last 12 hours.	1e. Sudden or erratic trace deviations. No trace. Trace and WET WELL LEVEL controller LIC 103K reading disagree.	1e. Check wet well level, raw sewage pump operation, and gate levels to assure proper station functioning. Adjust as required. If station is functioning correctly, perform authorized operator troubleshooting procedures. If recorder still malfunctions, notify supervisor.
1f. On WET WELL LEVEL recorder, purge pen, replace ink cartridge if necessary, and adjust as required.	– – –	– – –	– – –

Table 7-3. Raw Sewage Pumping System Operator Services (Cont.)

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY: (Cont.)			
1g. Reset CONTROL SELECTOR to original position (see step 1a) when checks are completed.	– – –	– – –	– – –
1h. Check mode controller(s) of running pump(s) (red indicator is on).	1h. Near setpoint.	1h. Above or below setpoint.	1h. Evaluate pumping rates and adjust as necessary.
2. At raw sewage pumps:			
2a. Check running pump(s) for noise and vibration.	2a. No unusual noise or vibration.	2a. Pump vibrating or noisy. **Note** *Excessive vibration will have automatically shut unit down (see table 7-2).*	2a. Shut down pump and notify supervisor.
2b. Check seals on nonoperating pumps and ensure that bypass needle valve on seal water mainfolds are closed.	2b. Stuffing box will be cold, but a small amount of clear water should be seeping out of box.	2b. No water or dirty water (raw sewage) seeping out of box.	2b. Adjust rotameter as required to acquire proper clear water seepage (item 2e). If unsuccessful, notify supervisor that pump may require seal replacement.
2c. Check mechanical seal on pumps that are running.	2c. Stuffing box(s)warm to the touch; small amount of clear water seeping out of box.	2c. Stuffing box(s) hot or cold. Dirty water (raw sewage) seeping out of box.	2c. Notify supervisor.
2d. Check bearings on pumps that are running.	2d. Bearings warm, but not hot, to touch.	2d. Bearings hot to touch. Possible odor.	2d. Shut unit down and notify supervisor immediately. Set up standby units for lead-follow operation (table 7-8).
2e. At running pump(s) seal water manifold(s), check C2 water flow rate.	2e. Rotameter indicates flow of about 0.5 gpm (1.9 lpm).	2e. Rotameter indicates more or less than 0.5 gpm (1.9 lpm).	2e. Adjust rotameter to about 0.5 gpm.
3. Check drive motor(s) of running raw sewage pump(s).	3. Motors operating with no unusual noise, vibration, odor, or fumes.	3. Other than normal (see "note" after item 2a).	3. Shut down effective unit and notify supervisor immediately. Set up standby units for lead-follow operation.

Table 7-3. Raw Sewage Pumping System Operator Services (Cont.)

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
WEEKLY:			
4. At main control panel, reassign pump operating sequences.	4. On Monday and Tuesday, the two pumps with least running time are placed in LEAD and FOLLOW position.	– – –	4. Change sequence each Monday, Tuesday, and Wednesday (see tables 7-4 through 7-8 as required).
5. In the wet well:			
5a. Test WET WELL HIGH LEVEL alarm AL 4 by lifting float switch FS 115.	5a. Alarm is triggered; locally, at WPTP, and at CATAD.	5a. Alarm is not actuated.	5a. Notify supervisor.
5b. Test standby pump starting circuit by lifting float switch FS 115B.	5b. Standby pump starts and accelerates to preset speed.	5b. Standby pump does not start.	5b. Check motor controller for open circuit breaker, blown secondary fuse, or thermal overload. Check local control stations for latched STOP pushbuttons. Check appropriate selector for AUTO position. If all circuits and controls are all right and pump fails to start, notify supervisor.
MONTHLY:			
6. Dismantle and clean wet well level bubbler and pump seal water manifold rotameters.	– – –	– – –	– – –
7. Lubricate system equipment according to lubrication schedule (table 3-1) and manufacturer's data.	– – –	– – –	– – –
Note *Motor bearing lubrication schedule also mounted on drive unit.*			



East Marginal Way Pumping Station

Table 7-4. Raw Sewage Pumping System – Prestart

Note

This procedure assumes that pumping system is completely shut down.

PROCEDURE

1. Verify that wet well level is above pump lockout elevation (94.0).

2. Place station CONTROL SELECTOR to LOCAL.

3. Place all pump mode (HAND/OFF-RESET/AUTO/PUMP DN) selectors to OFF.

4. At each pump seal water manifold, open inlet and discharge valves. Verify that water is seeping from pump stuffing box.

5. Unlatch each raw sewage pump STOP pushbutton in motor and pump rooms.

6. At MCC, place each pumping unit circuit breaker to ON. READY (green) indicator comes on.

Table 7-5. Raw Sewage Pumping System – Startup and Automatic Operation

PROCEDURE

Note

This is the normal operational mode.

1. Complete system prestart procedures (table 7-4).

2. Using pump duty selectors (LEAD, FOLLOW, STANDBY), assign pump starting sequence.

3. Place all pump mode (HAND/OFF-RESET/AUTO/PUMP DN) selectors to AUTO. AUTO (amber) status indicators on respective MCC compartments come on.

Note

Lead pump should start within 90 seconds after step 3. If pump does not start within 2 minutes, recheck steps 1 through 3. If lead unit fails to start, place its mode selector to OFF, troubleshoot, and/or change system starting sequence per table 7-8.

4. On respective MCC compartments, check that applicable AUTO (amber) and RUN (red) status indicators are on.

5. Place station CONTROL SELECTOR to CATAD. Press CATAD LOCKOUT RESET pushbutton to establish CATAD control.

Table 7-6. Raw Sewage Pumping System – Startup and Manual Operation

PROCEDURE

Use manual or HAND mode for short-term immediate pumping rate changes or if automatic control is impractical or malfunctioning. Closely monitor speed, current, and wet well effects. Use manual mode for routine weekly lowering of the wet well for flushing of side walls, gate guides, etc. Do not confuse it with PUMP DowN mode, which is primarily for maintenance.

The following procedure assumes that the system is completely shut down. One or all three units may be controlled manually. All automatic circuits except alarm and pump lockout are bypassed.

1. Perform system prestart procedures (table 7-4).

2. Rotate (verify) each pump SPEED ADJUSTment fully counterclockwise to 0 (zero).

Note

If automatic standby pump operation is desired during manual operation of the other units, place its mode selector to AUTO, its starting sequence selector to STANDBY, and preset its SPEED ADJUST to desired speed.

3. Place mode selector of each pump selected for manual operation to HAND. READY indicator (green) on MCC compartment goes out; RUN indicator (red) comes on.

4. Adjust each pump SPEED ADJUSTment to reach or maintain desired wet well level.

5. Closely monitor WET WELL LEVEL controller LIC 103K and each pump speed indicator during manual operation.

COMMENT

Pumping the wet well down below elevation 94.0 automatically triggers WET WELL LOW LEVEL alarm AL 8 and shuts down the system.

Table 7-7. Raw Sewage Pumping System — Changing Pumping Modes During Operation

PROCEDURE

From Automatic to Manual

Changing from automatic to manual mode may be done on a system or individual basis. If all three units are to be changed simultaneously, place station CONTROL SELECTOR to LOCAL; otherwise leave CONTROL SELECTOR to CATAD.

1. Place (verify) SPEED ADJUST of unit(s) selected for manual control to 0 (zero).

CAUTION

If pump is running during mode change, pause at OFF when moving mode selector from AUTO to HAND, until pump stops completely; then place to HAND. Failure to comply could damage the pumps.

2. Place mode selector of selected pump(s) to HAND.

3. Manually control pump speed using respective SPEED ADJUST.

COMMENTS

In HAND mode, all automatic circuits except alarm, pump lockout, and CATAD lockout, are bypassed.

Shut down any unit not intended to operate either in HAND or AUTO mode before making changeover.

From Manual to Automatic

1. Place lead pump mode selector to OFF. Wait for pump to stop completely.

2. Place lead pump mode selector to AUTO.

3. Repeat steps 1 and 2 for follow pump.

4. If standby pump is in HAND mode, place its mode selector to AUTO in one smooth motion.

Note

If wet well level is above elevation 98.5, standby pump runs at preset speed independently of all other controls.

5. Rotate all pump SPEED ADJUSTments to 0 (zero).

6. If required, place station CONTROL SELECTOR to CATAD and press CATAD LOCKOUT RESET pushbutton to restore CATAD control.

Table 7-8. Raw Sewage Pumping System — Changing Pump Starting Sequence

PROCEDURE

Normally RSP #1 is lead unit Wednesday through Sunday; RSP #2 on Monday; and RSP #3 on Tuesday. In any case, normal procedure has either RSP #2 or RSP #3 as standby at all times. Current maintenance policy is to use one pump as lead unit most of the time to concentrate wear. The pump with the most accrued running time, as shown on the pump motor controller hour meter, is selected as lead unit.

1. Shut down all units (table 7-10).

2. Assign new starting (LEAD/FOLLOW/STANDBY) sequence.

3. Restart system in automatic mode (table 7-5).

4. Record change in station log and notify supervisor.

Table 7-9. Raw Sewage Pumping System — Wet Well Pumpdown

PROCEDURE

Wet well pumpdown is done up to three times a week depending on wet well condition. During this operation, all wet well level control circuits are bypassed, allowing the wet well to be pumped down below the wet well low level alarm and pump lockout elevation (94.0).

CAUTION

Do not pump wet well down below elevation 92.9 or pump cavitation and damage may result. Monitor WET WELL LEVEL controller LIC 103K closely!

1. If both lead and follow pumps are running, wait until the follow unit shuts down automatically.

2. Place station CONTROL SELECTOR to LOCAL.

Table 7-9. Raw Sewage Pumping System — Wet Well Pumpdown (Cont.)

3. Place follow pump mode selector to OFF.

4. Rotate lead pump mode selector to PUMP DN and hold.

Note

Mode selector must be held to PUMP DN. It is spring-loaded to return to AUTO when released.

5. Use lead pump SPEED ADJUST to regulate pump speed as necessary to lower wet well level without cavitating unit. Monitor wet well level closely on WET WELL LEVEL controller LIC 103K.

6. As wet well level decreases, second man hoses down side walls, gate guides, etc.

7. When hose down is completed, rotate SPEED ADJUSTment to 0 (zero).

8. When pump has slowed to minimum speed, release mode selector (it returns to AUTO). Press ALARM RESET pushbutton to clear WET WELL LOW LEVEL alarm.

9. Return all other pump mode selectors to AUTO.

10. Monitor check valve operation to check pump priming.

Note

Manual bleeding of air from pumps is normally unnecessary. Units have automatic bleed lines.

11. Place station CONTROL SELECTOR to CATAD.

12. Press CATAD LOCKOUT RESET pushbutton to restore CATAD control.

Table 7-10. Raw Sewage Pumping System — Shutdown

PROCEDURE

Shutdown may be implemented on a system or individual pump basis. If system is to be shut down, place station CONTROL SELECTOR to LOCAL; for individual unit shutdown, leave CONTROL SELECTOR to CATAD (this procedure assumes that system is in normal automatic mode). Shutdown, whether system or individual, is a routine procedure and may be used regularly in conjunction with other procedures (starting sequence change over, mode changes, etc.).

1. As required (see above), place station CONTROL SELECTOR to LOCAL.

2. Place pump mode selector(s) to HAND.

3. Rotate pump SPEED ADJUSTment(s) to 0 (zero).

4. When pump is at minimum speed, rotate its mode selector to OFF. RUN (red) and AUTO (amber) indicators go out; READY indicator comes on.

5. If pump is to be shut down for maintenance or for an extended period, lock out and isolate per table 7-11.

Table 7-11. Raw Sewage Pumping System — Pump Isolation

PROCEDURE

WARNING

Pumps that are shut down for maintenance must be locked out and tagged to prevent them from being inadvertently started. Failure to comply can result in death or injury.

1. Change pump starting sequence to place pump to be isolated in standby position (table 7-8).

2. Place mode selector of isolated pump to OFF.

3. At MCC, open, lock out and tag circuit breaker on pump motor controller.

4. In pump and motor rooms, press, latch, and tag pump STOP pushbutton.

5. Install slide gate in pump intake channel.

6. Open pump casing drain valve to vent pump and prevent possible gas buildup.

8. On pump seal water manifold, close shutoff valve.

COMMENT

A pump is normally isolated for extended shutdown or maintenance activities such as repair, internal inspection, debris removal, or repair of force main. Motor or drive shaft maintenance may also require isolation and possible internal flushing if unit will be shut down for an extended period.

AIR SYSTEMS

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SECTION VIII
AIR SYSTEMS

INTRODUCTION

There are two independent air systems at the East Marginal Way pumping station; the instrument air system and the service air system. The instrument air system provides dry, regulated air for operation of bubblers and controllers. The service air system provides air for pressurization of the C2 water system hydropneumatic tank and for station maintenance and upkeep operations. Service air stations are in the control room, pump room, motor room, and wet well.

INSTRUMENT AIR SYSTEM

Physical Description

The instrument air system consists of the components shown in figure 8-1. The system supplies clean, dry air to operate controls or devices in the raw sewage pumping system and the sump drainage subsystem.

Power is supplied to the instrument air compressor motors through MCC 460-volt motor controllers, B2 and B3. The compressor LEAD selector is on controller, B1. Table 8-1 lists system equipment characteristics.

Functional Description

The instrument air compressors supply air to the receiver which stores it at 29 to 52 psi (2.0 to 3.7 kg/sq cm) for release through the distribution manifold inside the main control panel (see figure 7-1, sheet 3) to pump room sump and influent channel bubblers. Blowdown valves enable condensed moisture to be purged from the manifold. The two compressors operate in parallel according to the following schedule, with either one selected as lead unit by the LEAD selector on MCC compartment B2. Alarms are triggered at the main control panel annunciator (AL 6) and at the CATAD control console. If the instrument air compressors are inoperative, the service air system can supply the bubblers through the distribution manifold by opening the cross-connection valve between the systems. TEST (START)/STOP-lockout stations are used to locally test and lock out the compressors. Pressing and holding the TEST (START) pushbutton starts and runs the associated compressor until released. Pressing the STOP pushbutton deenergizes the compressor motor control circuit as long as the button is held. A manually-operated latch holds the STOP pushbutton down to maintain equipment shutdown.

FUNCTION	PRESSURE SWITCH	FALLING PRESSURE	RISING PRESSURE
Lead Compressor on	PS 111	29 psi (2.0 kg/sq cm)	
Lead Compressor off	PS 111		52 psi (3.7 kg/sq cm)
Follow Compressor on	PS 118	18 psi (1.3 kg/sq cm)	
Follow Compressor off	PS 118		42 psi (3.0 kg/sq cm)
Alarm on	PS 111B	20 psi (1.4 kg/sq cm)	
Alarm off	PS 111B		35 psi (2.5 kg/sq cm)

Alarm Indications

Instrument air system alarms and corrective actions are listed in table 8-2.

Operator Services

Periodic operator-performed instrument air system services and checks are described in table 8-3. An illustration on the last page of the table shows where each service is performed.

Operating Procedures

The instrument air system operates independently of all other systems, but its support of other systems is essential. It must remain operational at all times. Instrument air system operating procedures are described in table 8-4.

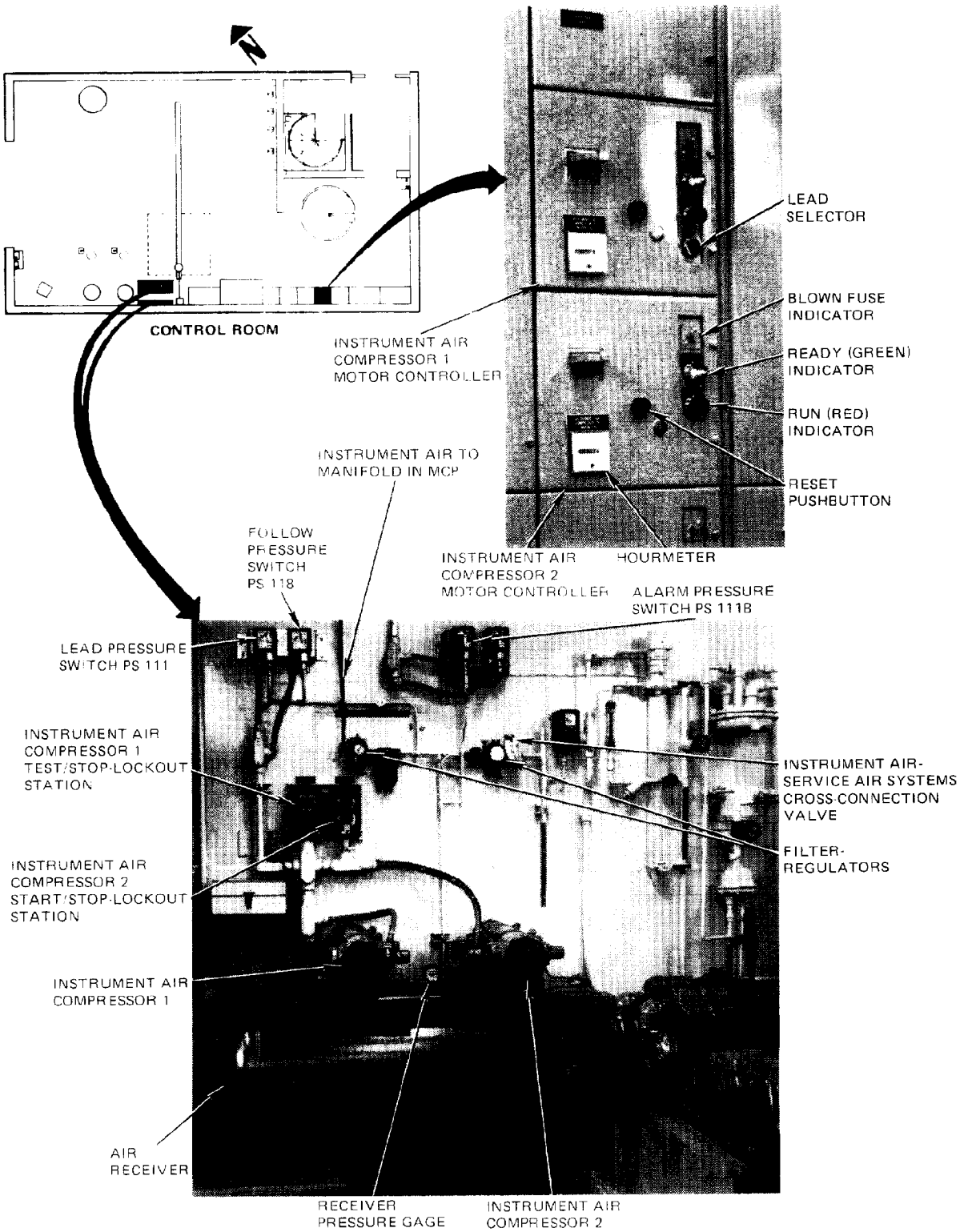

Figure 8-1. Instrument Air System Equipment

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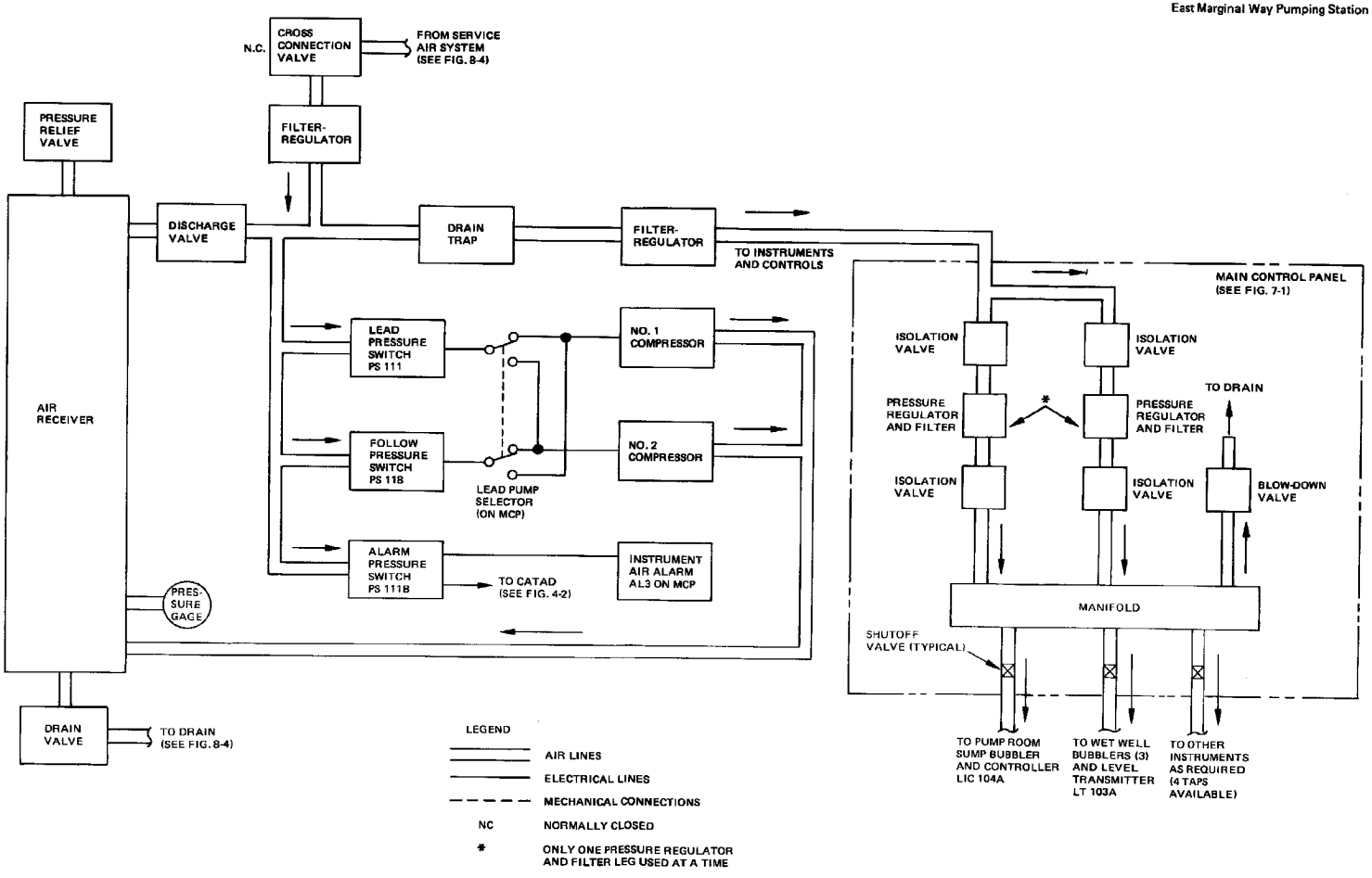

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Figure 8-2. Instrument Air System Functional Diagram

Table 8-1. Instrument Air System Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
Air Compressors (2)		ITT Pneumotive model DTOGH 715-T; capacity – 5.5 scfm (0.16 cu m/min) at 75 psi (5.3 kg/sq cm)
Motors (2)		Gould Inc., Century Electric Division, part No. 8-141003-01, frame M56Y, type SC; rating – 1.5 hp (1.1 kw) at 1,725/1,425 rpm, 60 Hz, 3-phase, 230/460 V, 4.6/2.3 A
Air Receiver		Roy E. Hanson Jr. Mfg., model MAW 200-650; capacity – 80 gal (303 l); working pressure – 200 psi (14 kg/sq cm)
Pressure Switches (2) (Lead, Follow)	PS 111 PS 118	Square D Co., class 9012, type ACW 1; range – 1 to 110 psi (0.07 to 7.7 kg/sq cm)
Pressure Switch, Alarm	PS 111B	Square D Co., class 9012, type ACW 28; range – 20 to 180 psi (1.4 to 12.7 kg/sq cm)
Filter-Regulators (2)*		Conoflow Corp., model FH-60XT; range – 0 to 25 psi (0 to 1.8 kg/sq cm) *One in service at all times, the other only during service to instrument air system cross-connection (see figure 8-1 and table 8-4).

Table 8-2. Instrument Air System Alarm Indications

ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
AT MCP ANNUNCIATOR:			
INSTRUMENT AIR (AL 3)	PS 111B	At or below 20 psi (1.4 kg/sq cm)	Check that compressors are operating. If not, check motor controllers (MCC panel B2 and B3) for tripped breakers. Reset breakers, if necessary. If compressors operate properly, check for leakage in air lines. Make temporary repairs, as possible. If compressors do not operate properly, lock out unit, notify supervisor. Record action in station log.

Table 8-3. Instrument Air System Operator Services

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY			
1. At the instrument air receiver:			
1a. Check pressure gage.	1a. Between 29 and 52 psi (2.2 and 3.7 kg/sq cm).	1a. Other than normal.	1a. Test compressors. If not operating properly, lock out and select other unit for lead. Notify supervisor. Record action in station log.
1b. Purge receiver.	1b. Small amount of water should be expelled.	– – –	– – –
2. At instrument air compressor:			
2a. Test each unit by pressing and holding TEST pushbutton.	2a. Compressor will start unloaded, then load, then stop, and unload shortly afterward.	2a. Other than normal.	2a. Check that circuit breakers at MCC controller units are ON. If compressor fails to load or unload, lock out unit and notify supervisor. Record condition in station log.
2b. Check filter elements and housings.	2b. Filters not excessively dirty; housings secure.	2b. Other than normal.	2b. Replace filter elements and secure housings as required.
WEEKLY			
3. Drain water from distribution manifold, all air lines, and regulators.	3. Small amount of water should be expelled.	– – –	– – –
4. Per schedule, at instrument air compressor No. 1 motor controller (B2), change lead compressor by turning LEAD selector from 1 to 2, or 2 to 1, as appropriate.	**Note** *Compressor 2 normally operates in lead position for two weeks; compressor 1 for one week.*	– – –	– – –
MONTHLY			
5. At instrument air compressors, change intake filter elements.	– – –	– – –	– – –

Table 8-3. Instrument Air System Operator Services (Cont.)

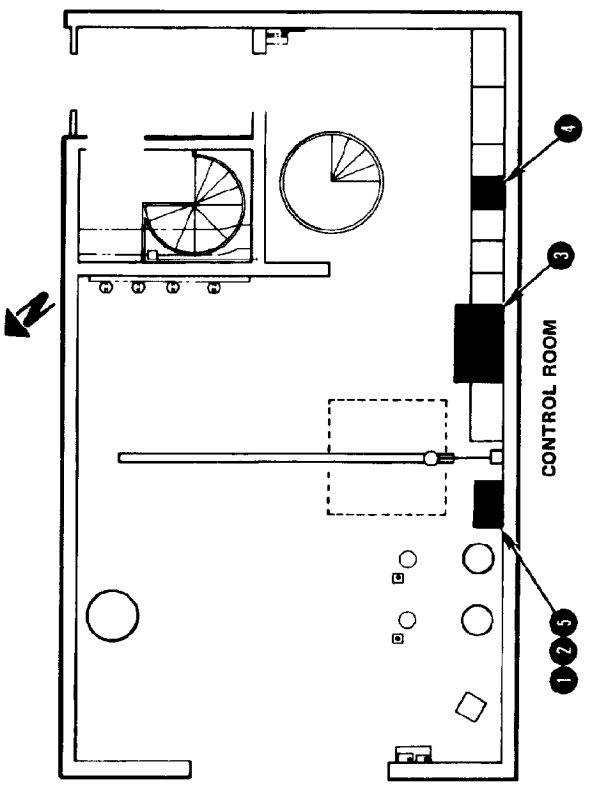

Table 8-4. Instrument Air System – Startup and Normal Automatic Operation

PROCEDURES

Startup

1. Perform operator services (see table 8-3, DAILY).

2. Unlatch STOP lockout pushbuttons at instrument air compressors local control stations (as required).

3. Open compressor discharge valves.

4. At MCC motor controller B2, place LEAD selector to 1 or 2.

5. At MCC motor controllers B2 and B3, place circuit breakers to ON. READY indicators (green), or if receiver pressure is low enough to trigger compressor operation, one or both RUNning indicators (red) comes on.

COMMENT

The instrument air compressors respond automatically to variations in receiver pressure (see schedule on page 8-3).

Shutdown

Note

To assure continuous system functioning, shut down only one unit at a time for maintenance.

1. At INSTRUMENT AIR COMPRESSOR #1 motor controller (MCC compartment B2), select unit not scheduled for maintenance as lead.

2. At local TEST (START)/STOP-lockout station for unit to be serviced, press, latch, and tag STOP pushbutton.

3. At MCC motor controller of unit to be serviced, place circuit breaker to OFF, lock out and tag.

COMMENT

To return unit to service, reverse above sequence.

Service To Instrument Air Cross Connection

This procedure is used only if the instrument air system is completely inoperative and repairs not immediately forthcoming. Because the service air compressors are crankcase-lubricated rather than oilless like the instrument air compressors, the instrument air lines and devices must be purged of oil residues and condensation immediately after cessation of service air use.

1. At local control stations, press and latch instrument air compressors STOP-lock pushbuttons.

2. At MCC motor controllers B2 and B3, open, lock out, and tag INSTRUMENT AIR COMPRESSORs circuit breakers.

3. At instrument air receiver, close receiver discharge valve.

4. On wall behind instrument air receiver, open instrument air-service air cross-connection valve (see figure 8-1). Adjust valve for 35 psi (2.5 kg/sq cm) reading on adjacent filter-regulator.

5. When instrument air system is ready for reactivation:

a. Close instrument air-service air cross-connection valve.

b. Purge instrument air lines and user devices of oil residues and moisture.

c. Open instrument air receiver discharge valve.

d. Perform system "Startup" procedures.

Note

Purging must be done quickly as wet well and sump level controllers and bubblers will be temporarily without air supply.

SERVICE AIR SYSTEM

Physical Description

The service air system consists of the components shown in figure 8-3, as well as service air supply stations throughout the station. The system pressurizes the C2 water system hydropneumatic tank, provides air for station maintenance and upkeep operations, and can supply the wet well and sump level control networks if the instrument air system fails. Power is supplied to the compressors through MCC motor controllers C1 and C2. The compressor lead-follow alternator is in MCC compartment A5. Table 8-5 lists system equipment characteristics.

Functional Description

The service air compressors supply air to the receiver which stores it at 95 to 125 psi (6.7 to 8.8 kg/sq cm).

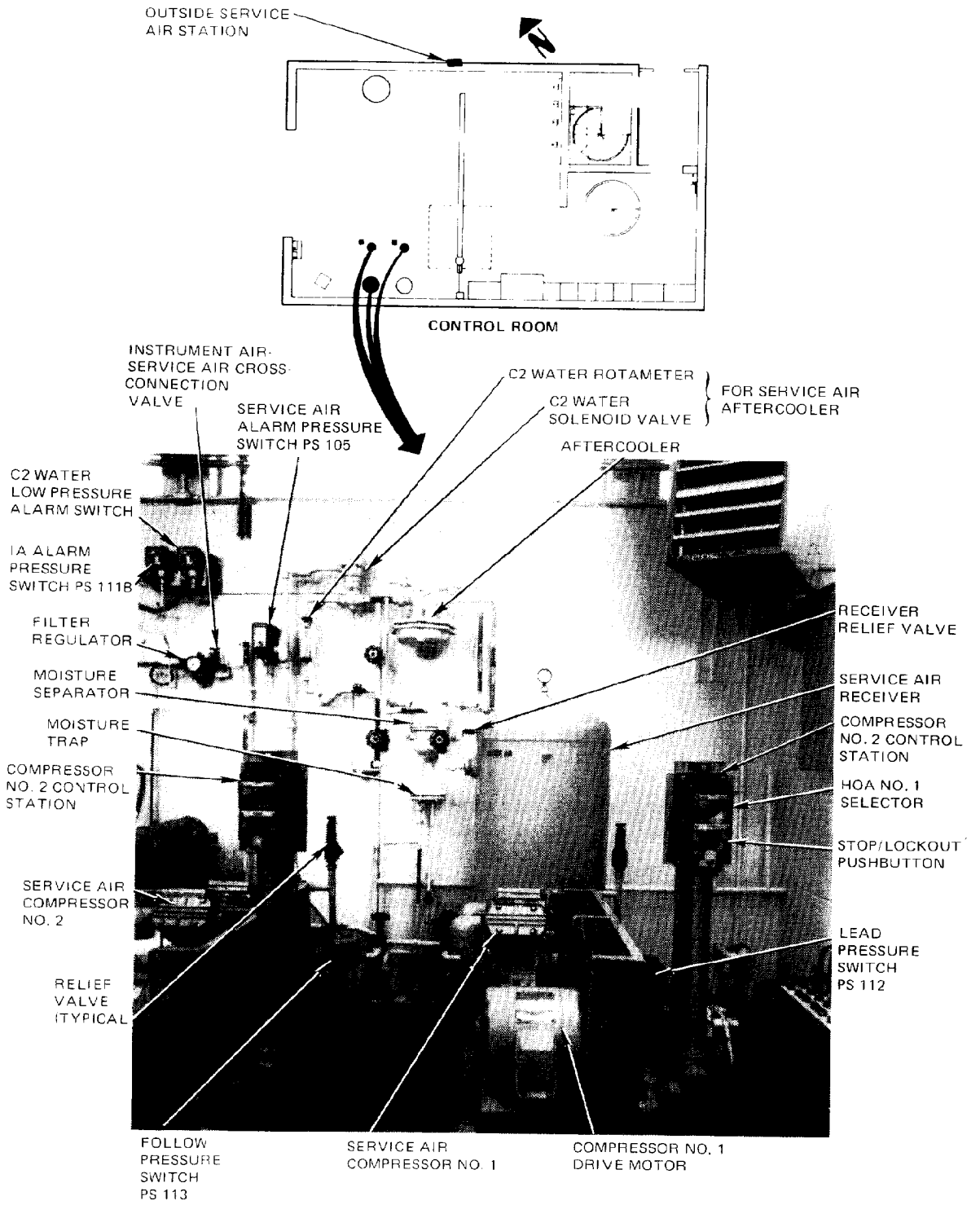

Figure 8-3. Service Air System Equipment (Sheet 1 of 2)

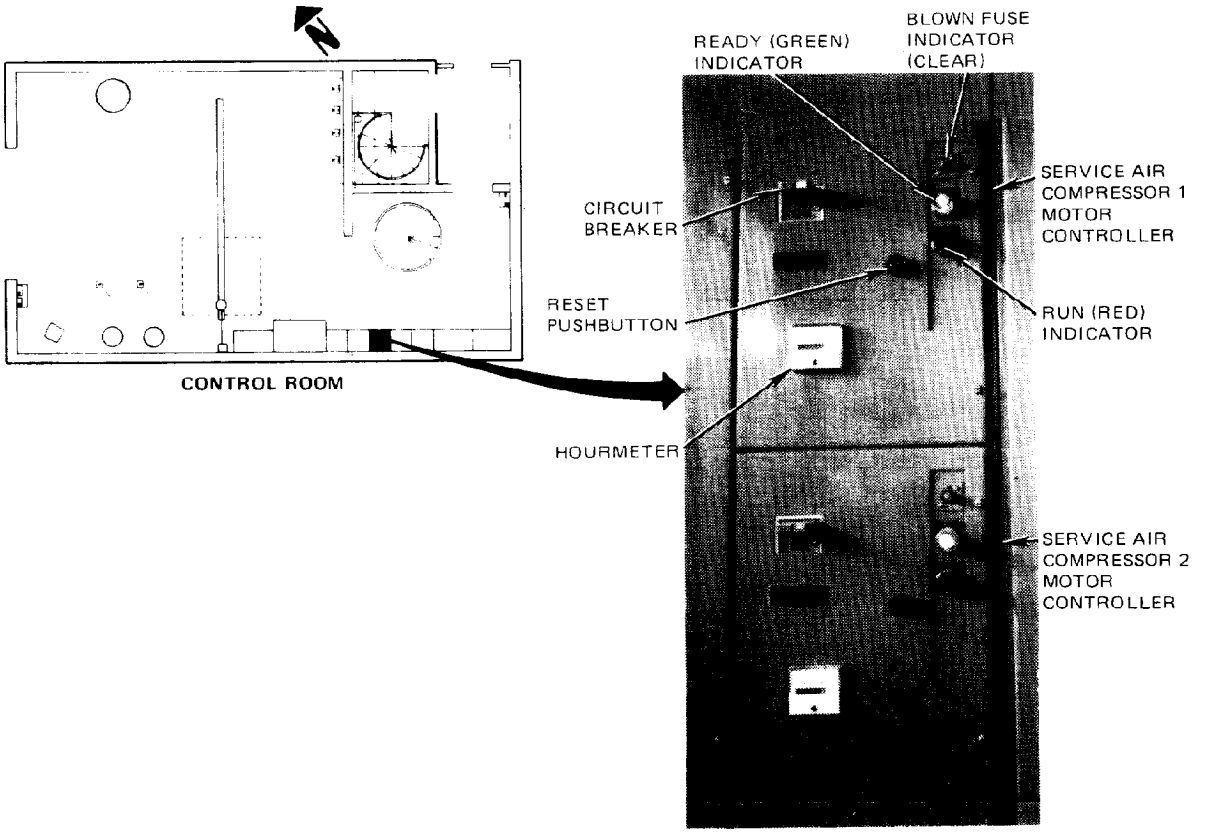

Figure 8-3. Service Air System Equipment (Sheet 2 of 2)

Compressor operating modes are selected by the mode (HAND/OFF/AUTO) selectors at the local control station at each unit. Normal operating mode is AUTO with the compressor operating in parallel according to the following schedule. Either unit may be selected as lead by the lead-follow alternator which then alternates the lead-follow sequence after each start. Placing the mode selector to HAND triggers continuous operation of the respective compressor. A compressor is locally shut down by either placing the mode selector to OFF or pressing and latching the STOP-lockout pushbutton below the mode selector. The aftercooler and moisture separator cool and dewater the air before it reaches the receiver. Pressure switch PS 105 triggers SERVICE AIR alarm (AL 11) at the MCP annunciator if system pressure drops below 78 psi (5.5 kg/sq cm). No remote alarms are triggered.

FUNCTION	PRESSURE SWITCH	FALLING PRESSURE	RISING PRESSURE
Lead Compressor on	PS 112	95 psi (6.7 kg/sq cm)	
Lead Compressor off	PS 112		125 psi (8.8 kg/sq cm)
Follow Compressor on	PS 113	104 psi (7.3 kg/sq cm)	
Follow Compressor off	PS 113		124 psi (8.7 kg/sq cm)
Alarm on	PS 105	78 psi (5.5 kg/sq cm)	
Alarm off	PS 105		110 psi* (7.7 kg/sq cm)

*MCP annunciator must be reset manually.

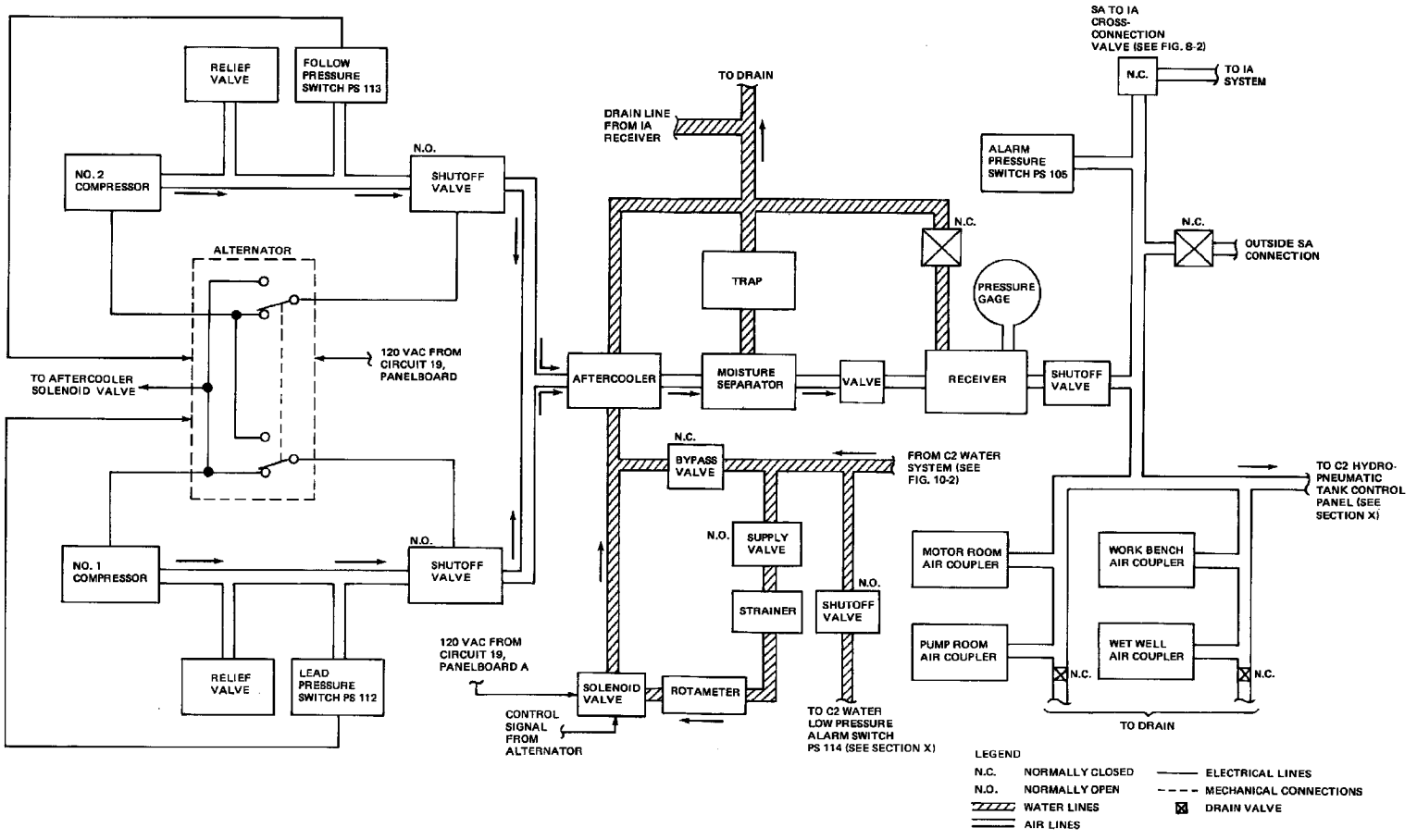

Figure 8-4. Service Air System Functional Diagram

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Alarm Indications

Service air system alarms and corrective action are listed in table 8-6.

Operator Services

Periodic operator-performed service air system services and checks are described in table 8-7. An illustration at the end of the table shows where each service is performed.

Table 8-5. Service Air System Equipment Characteristics

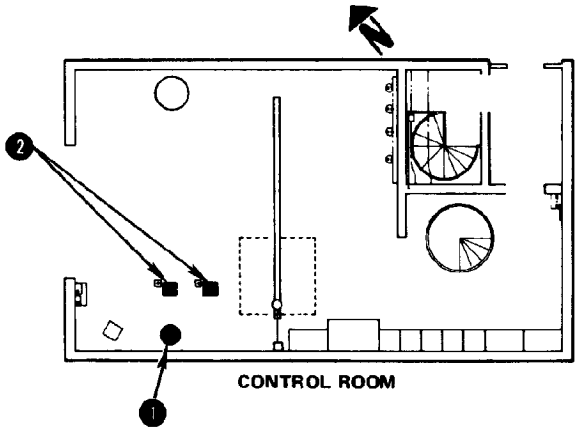
COMPONENT	METRO NUMBER	CHARACTERISTICS
Air Compressor No. 1		Ingersoll-Rand Co., two-cylinder, single-stage, model 222C4, type 30; size – 2-1/2 x 2-1/2 x 2-1/4; capacity – 7.5 cfm (0.2 cu m/min) at 150 psi (10.6 kg/sq cm)
Motor No. 1		General Electric Co., model 5K184AG201; rating – 1.5 hp (1.1 kw) at 1,730 rpm; 60 Hz, 3-phase, 220 V
Air Compressor No. 2		Same as No. 1
Motor No. 2		Westinghouse Electric Corp., model ABDP, frame 184; rating – 1.5 hp (1.1 kw) at 1,735 rpm; 60 Hz, 3-phase, 220 V
Air Receiver		Westinghouse Air Brake Co.; capacity – 60 gal (227 l); working pressure – 150 psi (10.6 kg/sq cm)
Moisture Separator		Wright-Austin, type T (1-1/4T-1S)
Trap		Wright-Austin, No. 90AC; bucket trap
Pressure Switches (2) (Lead, Follow)	PS 112 PS 113	Square D Co., class 9013, type GHG2, form Z
Pressure Switch (Alarm)	PS 105	Square D Co., class 9013, type ASG 11, form F
Aftercooler		Graham Heliflow, No. 4AA12; capacity – 40 cfm (1.1 cu m/min) at 100 psi (7 kg/sq cm)
Filter Regulator		Conoflow Corp., model FH-60XT; range – 0 to 60 psi (0 to 4.2 kg/sq cm)
Relief Valves (2)		J. E. Longergan Co., model ODP; size – 3/4-inch (1.91 cm)

Table 8-6. Service Air System Alarm Indications

ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
AT MCP ANNUNCIATOR:			
SERVICE AIR (AL 11)	Pressure Switch PS 105	Service air pressure at or below 75 psi (5.3 kg/sq cm)	Check that lead compressor is operating; if not, check motor controller for tripped breaker. Alternate compressors; if new lead compressor maintains load, notify supervisor that other compressor is defective. If both compressors operate properly, check for gross leakage in air lines. Make temporary repairs as possible and notify supervisor of repairs needed. Record all actions in station log.

Table 8-7. Service Air System Operator Services

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY			
1. At service air receiver, check pressure gage.	1. Between 100 and 130 psi (7.0 and 9.1 kg/sq cm).	1. Other than normal.	1. Test compressors. If lead compressor is not operating properly, lock it out and notify supervisor. Record action in station log.
2. At service air compressors:			
2a. Test each compressor by placing mode selector to HAND.	2a. Compressor will start and run until mode selector is placed to AUTO or OFF.	2a. Other than normal.	2a. Check that circuit breakers at MCC controller units are ON. If compressor fails to load or unload, lock out unit and notify supervisor. Report condition in station log.
2b. Check filter pads and holders.	2b. Filters not excessively dirty; holders secure.	2b. Other than normal.	2b. Replace filter pads and secure holders as required.
WEEKLY			
3. Drain water from all service air lines and regulators.	3. Small amount of water should be expelled.	– – –	– – –



Operating Procedures

The service air system operates independently of all other systems, but its support of other systems is essential. It must remain operational at all times. Service air sys .m operating procedures are described in table 8-8.

Table 8-8. Service Air System — Operation

PROCEDURES

Startup and Automatic Operation

1. Behind receiver, open compressor shutoff valves.

2. At compressor local control stations, place mode selectors to AUTO.

3. At MCC motor controllers C1 and C2, place circuit breakers on compressor motor controllers to ON. READY (green) indicator or RUNning (red) indicator comes on.

Manual or Continuous Operation

To operate a compressor independently of automatic control circuits, place mode selector at local control station to HAND. Unit runs continuously until mode selector is placed to AUTO or OFF.

Shutdown

Note

Shut down one compressor at a time for maintenance so that the system continues to function.

1. At local control station for compressor to be serviced, place mode selector to OFF, then press and latch STOP pushbutton.

2. Close isolation valve between compressor to be serviced and receiver.

3. At MCC motor controller for compressor to be serviced, place circuit breaker to OFF. Lock out and tag.

Service to Instrument Air Cross-Connection (see table 8-4).

HEATING AND
VENTILATING SYSTEMS

SECTION IX
HEATING AND VENTILATION SYSTEM

INTRODUCTION

The heating and ventilation system operates continuously to supply clean, fresh air throughout the station, remove hazardous, odor-producing gases from the wet well, and maintain a controlled temperature within the facility.

PHYSICAL DESCRIPTION

The heating and ventilation system consists of the equipment shown in figure 9-1, and the control and motor room exhaust fans. Major system equipment characteristics are listed in table 9-1.

Air Handling (Ventilation) Unit AHU-1

AHU-1 takes in outside air to cool RSP eddy current couplings 1 and 2 through a duct that connects louvers in the control room northeast wall to the top of the unit. The unit discharges into a duct that goes through the control room floor into the motor room and terminates in two louvers at RSP drive units 1 and 2. Power is supplied to AHU-1 through MCC motor controller D1.

Fans

Power is supplied to all five station fans from PANELBOARD A (see section V). The wet well exhaust fan, pump room transfer fan, and entry ventilation fan are all served through circuit breaker 16. The control room and motor room exhaust fans use circuit breakers 18 and 20, respectively.

Wet Well Exhaust Fan. The wet well exhaust fan is in the wet well access room. The fan intake duct extends down to the top of the influent channel. The exhaust duct exits the southwest wall of the access room into the exhaust plenum in the control room which rises to a discharge louver in the roof. The plenum drain line connects to the station storm drainage subsystem (see section XI).

Pump Room Transfer Fan. The pump room transfer fan, in the motor room near RSP motor 1, ingests air from both the motor room (through a damper in the intake duct) and pump room and transfers it into the wet well through the watertight wall.

Entry Ventilation Fan. The entry ventilation fan is inside the control room above the motor room stairway. It discharges into a duct that passes through the wet well access room to a grill in the vestibule southwest wall.

Control and Motor Room Exhaust Fans. Both of these fans discharge to the atmosphere; the control room fan through the roof, the motor room fan at ground level on the southwest side of the building. In each case, the discharge opening is provided with a damper to close it off when the fan is not in use.

A manual control station is on the wall near each fan. (The motor room exhaust fan has two; one inside the motor room near RSP #3 and one outside at the fan.) A panel of four red "running" indicator lamps (one for each fan except the entry ventilation fan) is on the wall below the entry ventilation fan.

FUNCTIONAL DESCRIPTION

In order to assure proper air circulation through each room and level of the station as shown in figure 9-2, the air handling unit and all fans should be operating. Once turned on, AHU-1 and the motor room exhaust fan are thermostatically controlled. A mode (HIGH/LOW/OFF/AUTO) selector on MCC controller D1 energizes AHU-1 and is normally placed to AUTO. In the HIGH or LOW positions, the unit operates continuously. In automatic mode, AHU-1 normally runs continuously at low speed, switching to high speed if motor room temperature rises to 85°F (30°C). The unit returns to low speed when room temperature drops to 65°F (18°C). The motor room exhaust fan runs continuously unless motor room temperature drops to 50°F (10°C), when it shuts down. All other fans are manually turned on and off.

The control room unit heater is a gas-fired unit controlled by a thermostat on the control room south wall. Power is supplied to the heater fan through circuit breaker 13 in PANELBOARD A. When control room temperature falls below the thermostat setpoint, the heater control valve opens and natural gas flows into the heater coil where a pilot flame ignites it. After a short time delay to heat the coil, the heater fan comes on and blows heated air into the control room. When the desired room temperature is reached, the thermostat closes the heater gas control valve. After the heater coil cools down, the fan stops. The natural gas pressure regulator and meter are outside the west corner of the building.

OPERATOR SERVICES

Periodic operator-performed heating and ventilation system checks and services are listed in table 9-2.

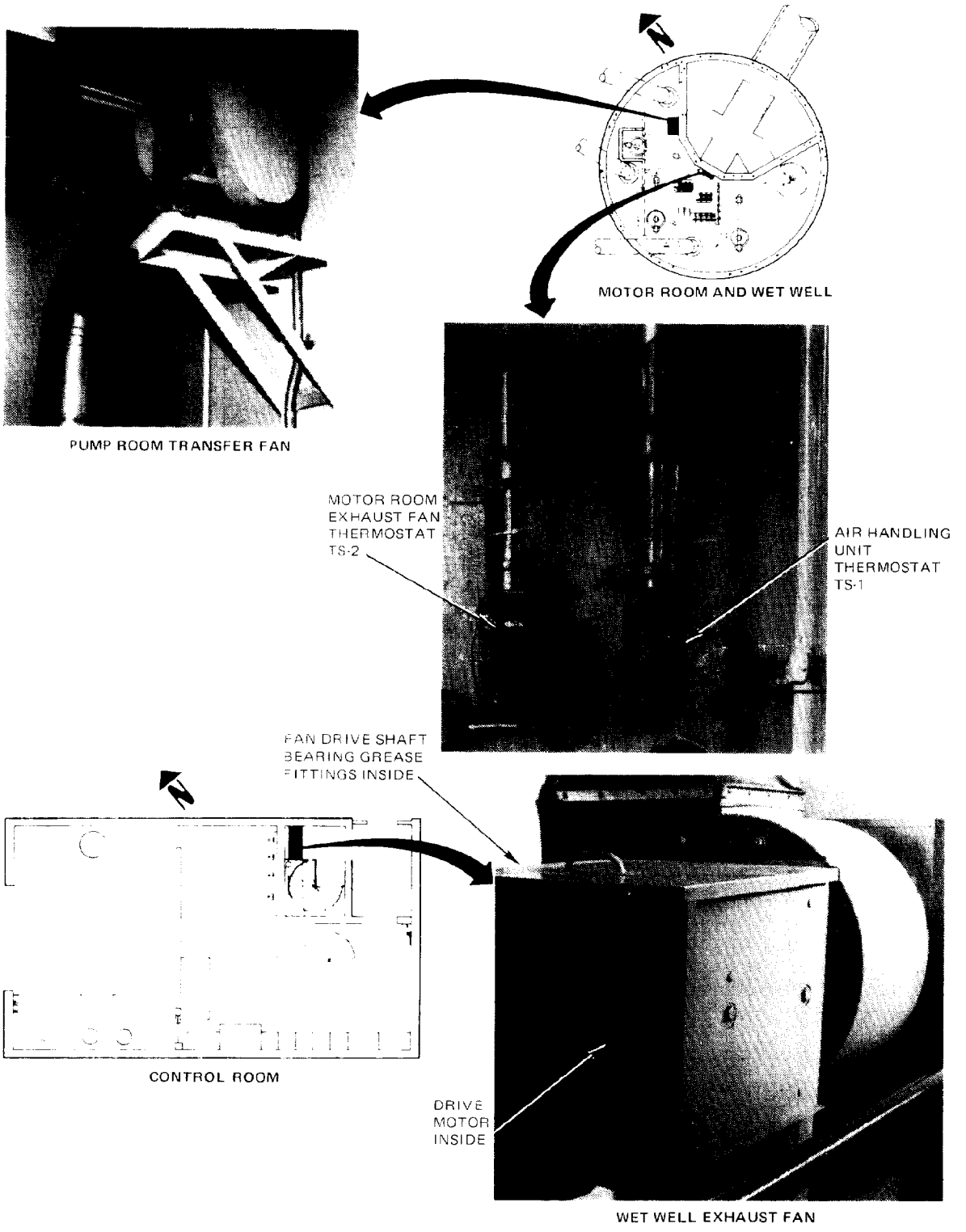


Figure 9-1. Heating and Ventilation System Equipment (Sheet 1 of 2)

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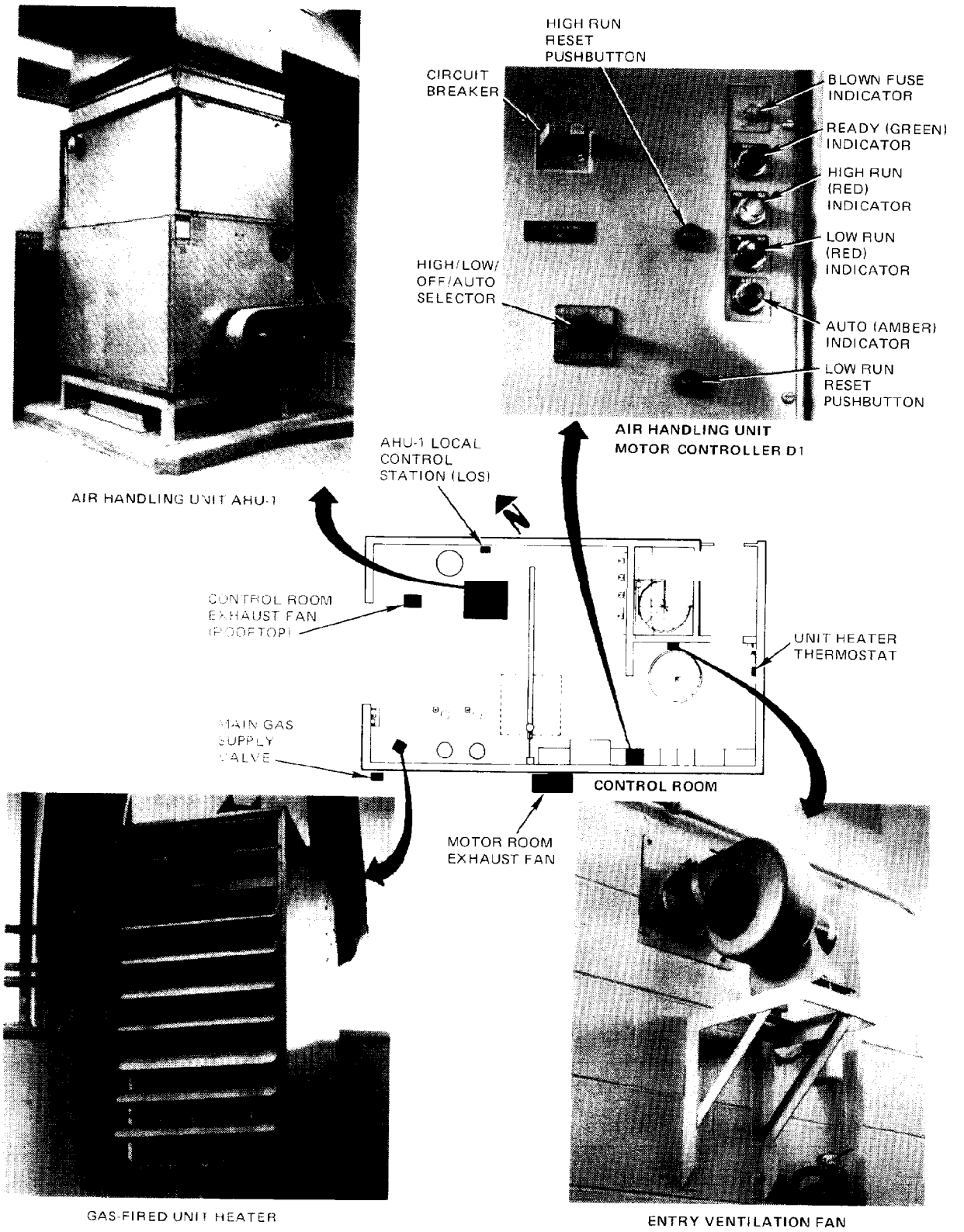


Figure 9-1. Heating and Ventilation System Equipment (Sheet 2 of 2)

Table 9-1. Heating and Ventilation System Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
Air Handling Unit	AHU-1	McQuay-Perfex Inc. Seasonvent model LYF 108 CI; capacity – 4,040 cfm (114 cu m/min) at 1,800 rpm
Motor		U.S. Electrical Motors Type T; rating – 1.0/0.5 hp (0.75/0.4 kw) at 1,800/900 rpm, 60 Hz, 3-phase, 460 V
Control Room Heater		Trane Company model GPA0100 SA, type 135-0504-4A; output – 80,000 Btu/hr (20,160 kg-cal/hr)
Thermostat		Janitrol; range – 55°F to 85°F (13°C to 29°C)
Ventilation Fan, Entry		New York Blower Company model 53 Junior; capacity – 114 cfm (3 cu m/min)
Exhaust Fan, Control Room		Greenheck Fan and Ventilator Corporation roof top model W4106; capacity – 950 cfm (27 cu m/min) at 1,210 rpm
Motor		Marathon Electric Company; rating – 1/4 hp (0.2 kw) at 1,725 rpm, 60 Hz, 1-phase, 115 V
Exhaust Fan, Motor Room		Greenheck Fan and Ventilator Corporation roof top model W4143; capacity – 1,980 cfm (56 cu m/min) at 1,070 rpm
Motor		Marathon Electric Company; rating – 1/3 hp (0.25 kw) at 1,725 rpm, 60 Hz, 1-phase, 115 V
Transfer Fan, Pump Room		New York Blower Company shop No. Z4435, type B, size 122; capacity – 1,600 cfm (45 cu m/min); motor rating – 1/3 hp at 1,725 rpm, 60 Hz, 1-phase, 115 V
Exhaust Fan, Wet Well		New York Blower Company shop No. Z4435, type B, size 150; capacity – 2,260 cfm (64 cu m/min); motor rating – 1/3 hp at 1,725 rpm, 60 Hz, 1-phase, 115 V
Thermostat, Air Handling Unit	TS-1	Setpoints – AHU-1 low to high speed at 85°F (30°C); high to low speed at 65°F (18°C)
Thermostat, Motor Room Exhaust Fan	TS-2	Setpoint – fan shutdown at 50°F (10°C)

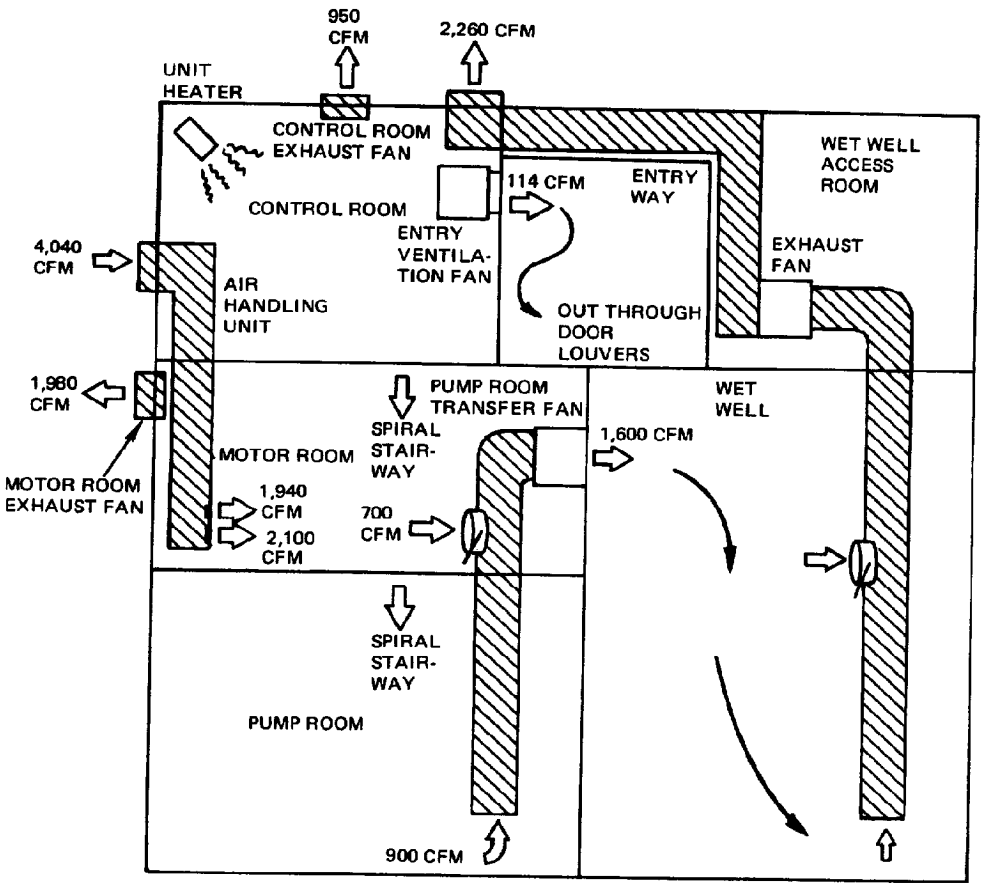


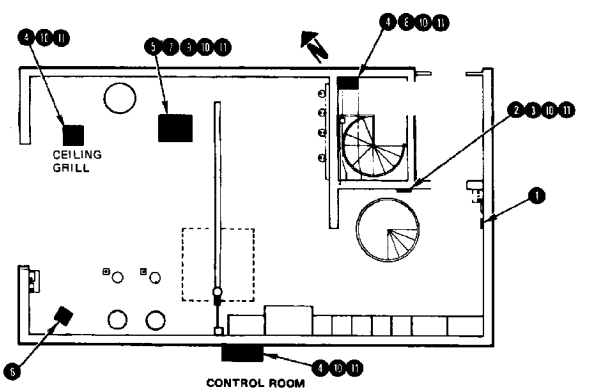
Figure 9-2. Station Air Circulating Diagram

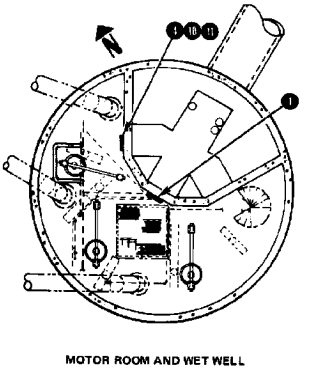
Table 9-2. Heating and Ventilation System Operator Services

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY			**Note** *Record all actions in station log.*
1. Check all thermostats for proper setting.	1. Thermostats at proper setting (see table 9-1).	1. Thermostats set improperly.	1. Check in log or with supervisor for reason for change. If none, return to proper setting.
2. Check "fan running" indicator panel on wall inside control room door. **Note** *Before proceeding with lubrication, adjustments, disassembly, or replacement, refer to manufacturers' data manuals for additional instructions.*	2. All indicators on. (MOTOR ROOM EXHAUST FAN; CONTROL ROOM EXHAUST FAN; PUMP ROOM EXHAUST (TRANSFER) FAN; and WET WELL EXHAUST FAN	2. One or more indicators not on.	2a. Physically check associated fan for operation (indicator bulb may be defective). If fans are not operating, check that PANELBOARD A circuit breakers 16, 18 and 20 are ON. 2b. Check log for possible reason for fan shutdown. 2c. Place (or verify) all fan ON/OFF switches to ON. If still off, notify supervisor.
3. Check entry ventilation fan for operation. ON/OFF switch is below "fan running" indicator panel.	3. Fan runs with no unusual noise or vibration.	3. Fan does not run or is excessively noisy or vibrating.	3. Check that circuit breaker 16 in PANELBOARD A is ON. **Note** *If circuit breaker is OFF, wet well exhaust and pump room transfer fans will also not run. If fan still does not run, notify supervisor.*
4. Check all other fans for proper operation (see step 2), including drive belt tension as applicable.	4. Units running with no unusual noise or vibration.	4. Condition other than specified.	4. Verify that appropriate circuit breakers and ON/OFF switches are ON. Adjust or replace drive belts as required. If excessively noisy or vibrating, place unit ON/OFF switch to OFF and notify supervisor.

Table 9-2. Heating and Ventilation System Operator Services (Cont.)

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY (Cont.)			
5. Check operation of AHU-1, including visual check of drive belt tension.	5. Unit operating at low speed with no unusual noise or vibration.	5. Condition other than specified. specified.	5. Adjust or replace drive belts as required. If unit vibrates or is excessively noisy, shut down, lock out (table 9-3) and repair as required. If problem cannot be corrected, notify supervisor. If unit is not running or is running at high speed when not required by motor room temperature, check MCC motor controller D1 for a tripped/OPEN circuit breaker and position of mode selector (normally placed to AUTO).
6. At control room unit heater:		WARNING *If gas leak is suspected, do not smoke or otherwise display open flame.*	
6a. Check for gas leaks.	6a. No leaks.	6a. Gas escaping. Leak may be detected by sound or smell.	6a. Close main gas supply valve (outside west corner of building), place heater gas valve selector to OFF, and notify supervisor.
6b. Check for lighted pilot flame.	6b. Pilot flame lit.	6b. Pilot flame out.	6b. Check position of main gas supply valve and heater gas valve selector. Notify supervisor and relight pilot flame as appropriate (table 9-5).
MONTHLY			
7. At air handling unit AHU-1, replace filter media.	– – –	– – –	– – –
8. At wet well exhaust fan, lubricate fan drive shaft bearings (see figure 9-1).	– – –	– – –	– – –
SEMI ANNUALLY			
9. At air handling unit AHU-1:			
9a. Check all moving parts for wear.	– – –	– – –	9a. Report excessive or suspicious wear to supervisor.
9b. Check bearing collar setscrews for lightness.	– – –	– – –	9b. Tighten as necessary.
10. At all units, lubricate motor bearings (see table 3-1).	– – –	– – –	– – –
EVERY TWO YEARS			
11. At all units, lubricate fan bearings (see table 3-1).	– – –	– – –	– – –





East Marginal Way Pumping Station

9-7 (9-8 blank)

OPERATING PROCEDURES

Tables 9-3, 9-4, and 9-5 list operating procedures for heating and ventilation system components that require them.

Table 9-3. Air Handling Unit Operation

PROCEDURES

Startup and Normal Automatic Operation

1. At AIR & VENTILATING UNIT local control station (see figure 9-1), unlatch (or verify) STOP pushbutton.

2. At MCC motor controller D1:

a. Place mode (HIGH/LOW/OFF/AUTO) selector to AUTO.

b. Place (or verify) circuit breaker to ON.

COMMENT

In automatic mode, AHU-1 runs continuously at low speed. Thermostat TS-1 in the motor room switches the unit from low to high speed and back to low speed as required by the ambient temperature.

Manual Operation

1. Unlatch local STOP pushbutton as described above.

2. At MCC motor controller D1:

a. Place (or verify) circuit breaker to ON.

b. Place mode selector to HIGH or LOW as required. Unit operates continuously at selected speed until mode selector is placed to AUTO or OFF.

Shutdown

1. At AIR & VENTILATING UNIT local control station, press and latch STOP pushbutton.

2. At MCC motor controller D1:

a. Place mode selector to OFF.

b. Place circuit breaker to OFF.

3. For extended shutdown, lock out circuit breaker (see table 5-4) and tag both circuit breaker and local STOP pushbutton.

Table 9-4. Fan Operation

All five station fans receive power through PANELBOARD A, are manually started and stopped from local control stations, and run continuously once energized. Thermostat TS-2 in the motor room will shut down the motor room exhaust fan, however, if motor room temperature drops to 50°F (10°C).

PROCEDURE

Startup

1. At PANELBOARD A, place circuit breakers 16 (wet well exhaust, pump room transfer, and entry ventilation fans), 18 (control room exhaust fan), and 20 (motor room exhaust fan) to ON.

2. At local control stations (see figure 9-1), place ON/OFF switches to ON. Appropriate "running" indicators on wall below entry ventilation fan come on.

Shutdown

1. At local control stations, place ON/OFF switches to OFF. Appropriate "running" indicators go out.

2. For extended shutdown, place appropriate circuit breakers in PANELBOARD A to OFF. Tag ON/OFF switches and circuit breakers.

Table 9-5. Control Room Heater Operation

PROCEDURES

Startup

1. Outside west corner of building, open (or verify) main gas supply valve.

2. At control room southeast wall, set thermostat to lowest setting.

3. At heater, place gas valve selector to PILOT.

4. Ignite a twist of paper, press gas valve selector, and apply flame to pilot jet. Hold selector down for at least 1 minute.

5. Release gas valve selector. Pilot flame should remain lighted. If not, repeat step 4.

6. Rotate gas valve selector to ON.

7. Adjust heater thermostat to desired temperature setting.

Pilot Flame Restoration

If pilot flame goes out while heater is operating, relight and restore unit to service as follows:

1. Place gas valve selector to OFF for at least 5 minutes.

2. During the interval, adjust heater thermostat to lowest setting.

3. When 5 minutes have elapsed, place gas valve selector to PILOT and proceed with rest of normal "Startup" procedure.

Shutdown

1. At heater, place gas valve selector to OFF.

2. Close main gas supply valve.

3. Place heater thermostat to lowest setting.

C1 & C2 WATER SYSTEMS

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SECTION X
C1 AND C2 WATER SYSTEMS

INTRODUCTION

City water enters the pumping station through a 1.5-inch (48-mm) line. Inside the station, the C1 system distributes water to personnel facilities, and irrigation sprinklers, and fills the C2 system reservoir. The C2 water system supplies water for plant maintenance operations, influent gate operation, raw sewage pump clear water seals, and service air cooling. Systems' equipment is shown in figure 10-1. Table 10-1 lists equipment characteristics. Figure 10-2 is a combined systems functional diagram.

C1 WATER SYSTEM

The C1 system supplies clean water for drinking, washing, and general use, but is not used for station washdown, pipe or pump flushing, or general maintenance work.

Physical Description

The C1 water system (figure 10-1) begins at the reduced pressure backflow preventer on the incoming line and ends at the C2 system air break tank flow control valve. Two lines, with isolation valves, branch off the incoming line. One supplies the washroom and service sink; the other the irrigation sprinklers. The irrigation network contains solenoid control valves in underground valve boxes, vacuum breakers, shutoff and drain valves, and sprinkler heads. A controller in the control room establishes the day, time, and duration of sprinkler operation.

Functional Description

The C1 water system receives potable water from the City of Seattle (figure 10-2). The reduced pressure backflow preventer prevents C1 water from flowing back into the city water system. The solenoid control valves in the irrigation sprinkler supply lines control water flow to segments of the sprinkler network as directed by the irrigation control panel. The vacuum breakers in the supply lines prevent air lock. Circuit breaker 14 in PANELBOARD A supplies 120-VAC power to the irrigation control circuit.

C2 WATER SYSTEM

Physical Description

The C2 water system (figure 10-1) consists of the air break tank (C2 reservoir) and the C2 high pressure subsystem.

Air Break Tank (C2 System Reservoir). The air break tank is in the north corner of the control room (see figure 10-1, sheet 1 of 3). Ancillary equipment includes a C1 water flow control valve, a float-operated pilot valve, a 1-inch (33-mm) drain line, and a 3-inch (89-mm) overflow. The drain and overflow lines combine before discharging through the control room northwest wall to the station apron.

C2 High Pressure (HP) Subsystem. The C2HP subsystem consists of C2 water pumps 1 and 2, a single TEST/STOP-lockout control station, a pump selector, MCC motor controller D2, three hose stations (control room, pump room, and wet well), an outside wall hydrant, the hydropneumatic tank with high water level probe, and subsystem low pressure alarm switch PS 114.

Functional Description

Air Break Tank. The air break tank separates the C1 and C2 water systems to prevent contamination of either the C1 or city water system (figure 10-2). The air break tank is automatically supplied from the C1 system through the tank flow control valve which opens and closes as the pilot valve float rises and falls with the changing tank water level to maintain a water depth of 18 inches (46 cm) or elevation 117.5. The tank overflows at a depth of 21 inches (53 cm) or elevation 117.75.

C2 High Pressure (HP) Subsystem. This subsystem supplies water for RSP clear water seals, hose stations and hydrants, influent sluice gate operation, and service air aftercooling. Normal subsystem pressure is 80 to 100 psi (5.6 to 7.0 kg/sq cm) and is maintained by the hydropneumatic tank. Working water level is a depth of 18 inches or elevation 117.38.

A floating disc inside the tank separates air from water (see figure 10-2). The tank is charged with service air above the disc to about 30 psi (2.0 kg/sq cm). The C2 water pumps supply water from the air break tank to the area below the disc, forcing the disc upward against the air charge to attain and maintain subsystem pressure. As water is used from the hydropneumatic tank, pressure decreases until at 80 psi (5.6 kg/sq cm), the hydropneumatic tank controller energizes the duty water pump until pressure again reaches 100 psi (7.0 kg/sq cm). [Only one C2 water pump operates at a time as determined by the pump selector (see table 10-4).]

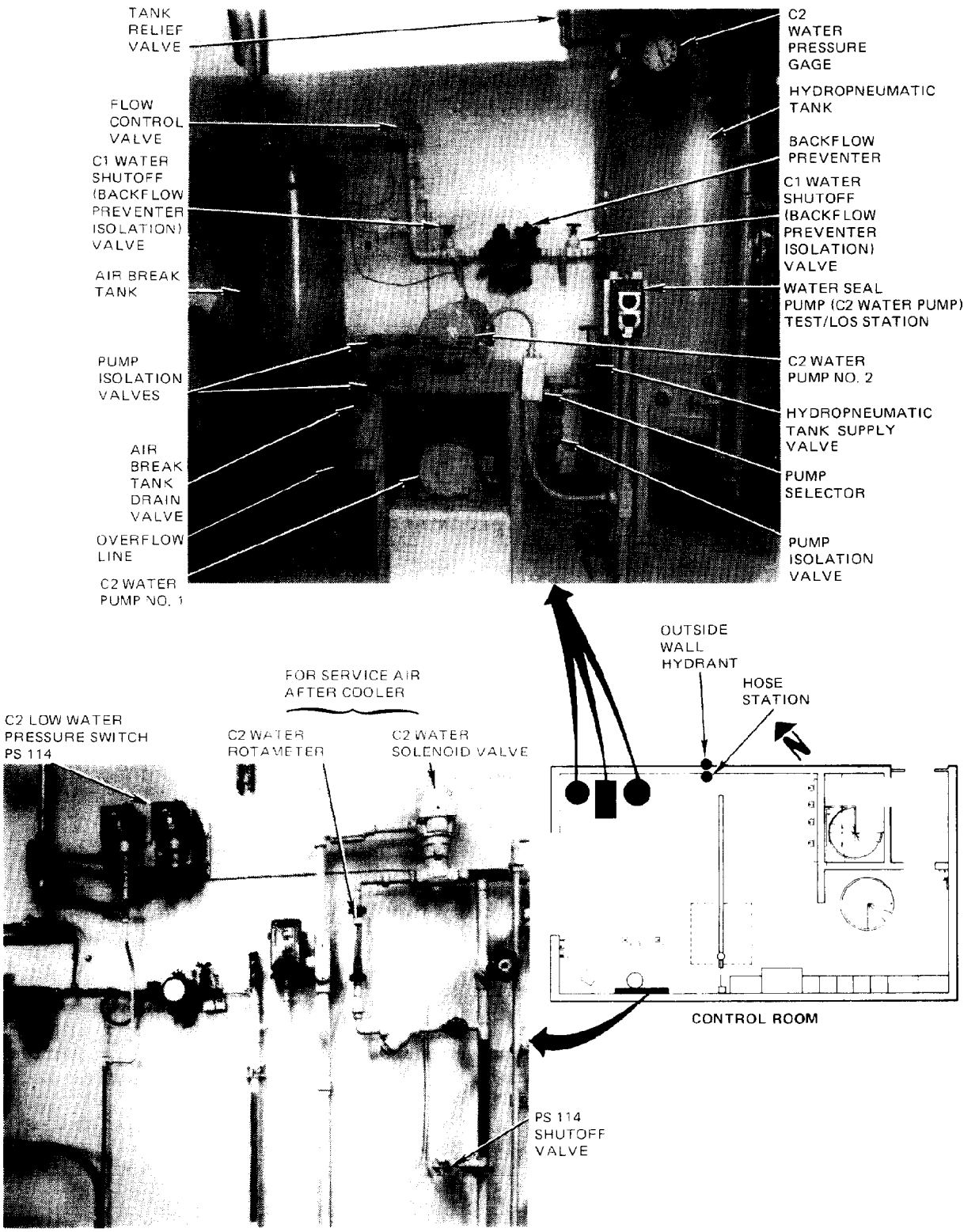

Figure 10-1 C1 and C2 Water Systems Equipment (Sheet 1 of 3)

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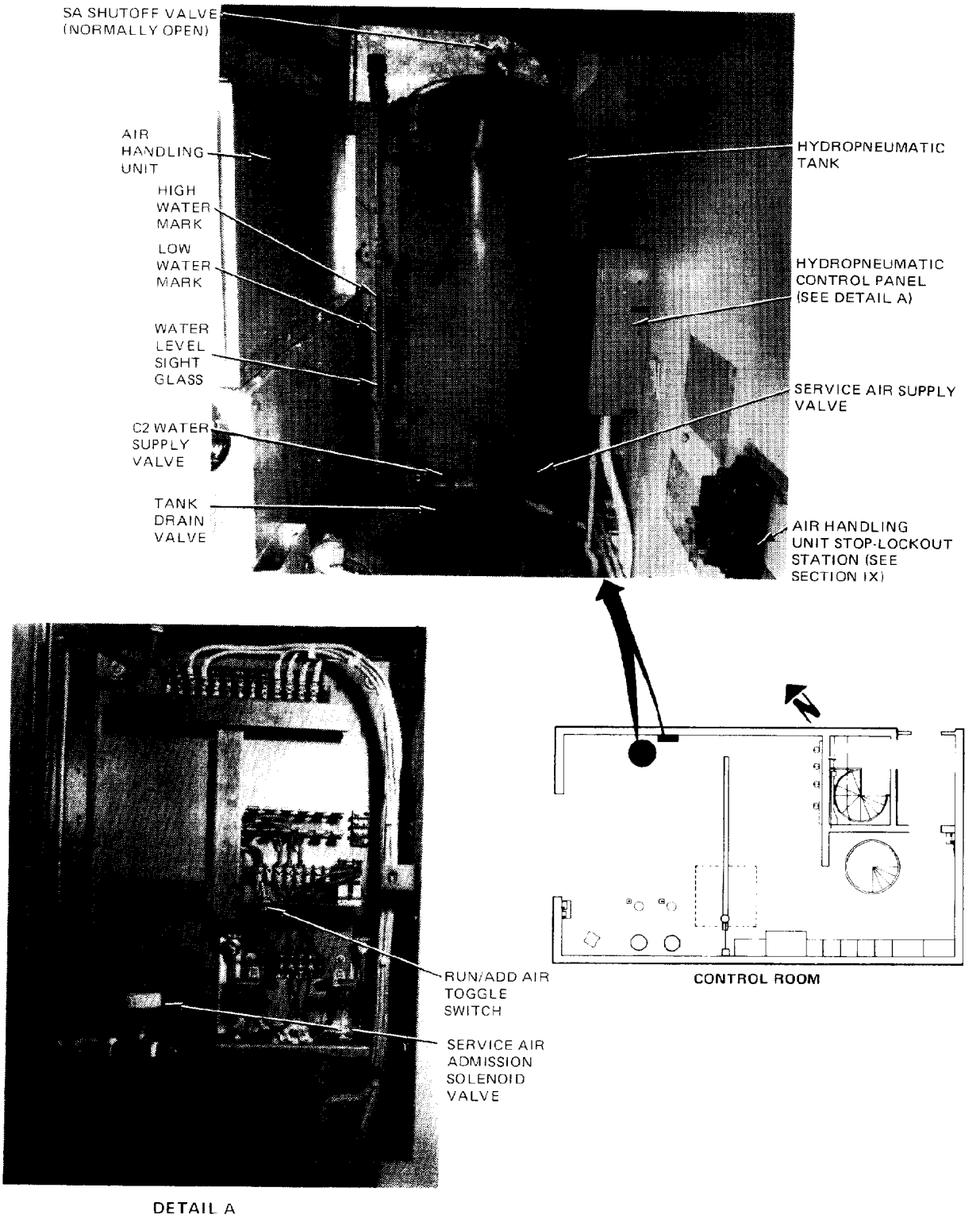


Figure 10-1. C1 and C2 Water Systems Equipment (Sheet 2 of 3)

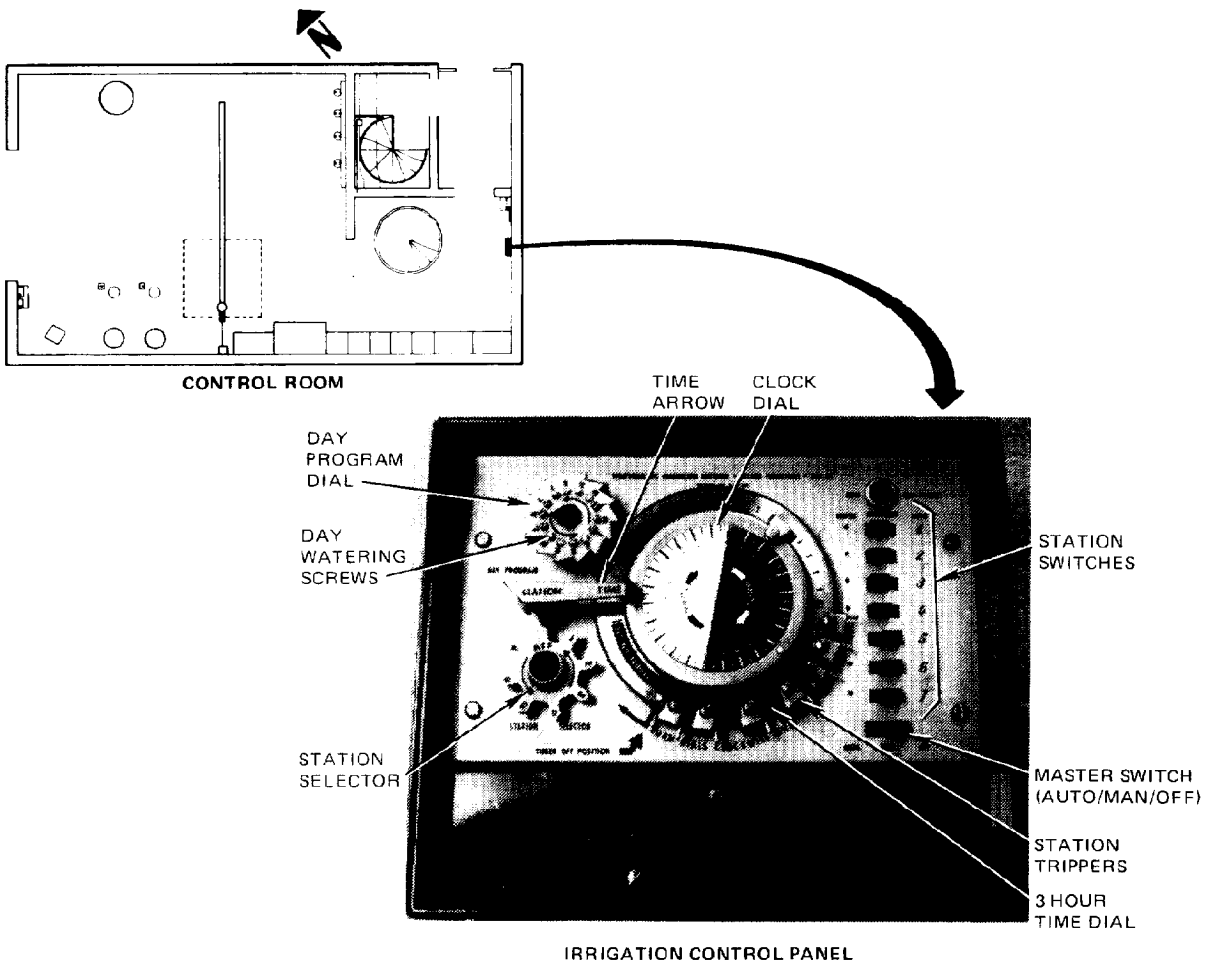


Figure 10-1. C1 and C2 Water Systems Equipment (Sheet 3 of 3)

Over a period of time, the air and water in the hydropneumatic tank tend to mix about the edge of the floating disc, causing the water pump to run more and more frequently in order to maintain subsystem pressure and also slowly raising the tank water level. If tank water level rises to a water depth of 43 inches (1.1 m) or elevation 119.5, a control probe in the tank sight glass triggers local alarm AL 6 (C2 WATER SYSTEM). This indicates to the operator that the tank service air charge must be renewed (table 10-6).

Should subsystem pressure drop below 25 psi (1.8 kg/sq cm), C2 LOW WATER PRESSURE SWITCH PS 114 triggers alarms both at the CATAD central console and at the MCP annunciator (AL 6, C2 WATER SYSTEM).

Table 10-1. C1 and C2 Water Systems Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
C1 WATER SYSTEM:		
Backflow Preventer		Hersey-Sparling Meter Co., Hersey Div.; Beeco model 6C; 1-1/2-inch (3.81 cm) pressure type with isolating valves
Irrigation Control Panel		Telsco Industries, Weathermatic model EM7-24; input – 115 VAC, 60 Hz, 1.3 amps maximum; outputs – 26 VAC or 120 VAC
Shrub Spray (8)		Buckner, model 403 HS
Shrub Spray (5)		Buckner, model 403 HUS
Strip Spray (9)		Buckner, model 400 STDA
Shrub Spray		Buckner, model 403; 0.75 inch (19 mm) US
Shrub Spray		Buckner, model 403 FUS
Automatic Valve (2)		Moody, No. 6125
Vacuum Breaker (2)		H. L. Gee, No. 305
Hot Water Tank		Appliance Building Co. model ER1-1/2; capacity – 1-1/2 gal (5.7 l); single-phase, 120 V
C2 WATER SYSTEM:		
Air Break Tank (C2 Reservoir)		18 inches (46 cm) diameter x 36 inches (91 cm) high; capacity – 40 gal (150 l)
C1 Water Flow Control Valve		Singer Valve Co. Ltd. (the Canadian Valve Engineering Co.); Series 106-F, type V, 1-1/2-inch (48-mm) external pilot-controlled float valve
Flow Control Valve Pilot Valve		Singer Valve Co. Ltd., pilot float control valve, PFC type A; float operated; maximum working pressure – 300 psi (21 kg/sq cm)
C2 Water Pump No. 1		Roth Turbine Pump model A256BF; capacity – 20 gpm (0.08 cu m/min) at total head of 175 feet (53.3 m)
Motor		Wagner model 184-66481-00, type RP1; rating – 2 hp (1.5 kw) at 1750 rpm; 60 Hz, 3-phase, 460 V
C2 Water Pump No. 2		Same as No. 1 except model A256SF
Motor		Same as No. 1 except model 184-11575-00
Hydropneumatic Tank Controller		Automatic Control Company, Duotrol model with control probe inside hydropneumatic tank sight glass

Table 10-1. C1 and C2 Water System Equipment Characteristics (Cont.)

COMPONENT	METRO NUMBER	CHARACTERISTICS
Hydropneumatic Tank		National Steel Construction; 2.5 feet (0.8 m) diameter x 6.0 feet (1.8 m) high; working pressure – 150 psi (10.6 kg/sq cm)
Service Air Admission Solenoid Valve (In Hydropneumatic Control Panel)	SV 110	Automatic Switch Co., 110 volts, 60 Hz, 1-phase
Low Water Pressure Alarm Switch	PS 114	Square D Co., class 9012, type ACW 28; range – 20 to 180 psi (1.4 to 12.7 kg/sq cm); differential – 5 to 40 psi (0.4 to 2.8 kg/sq cm)

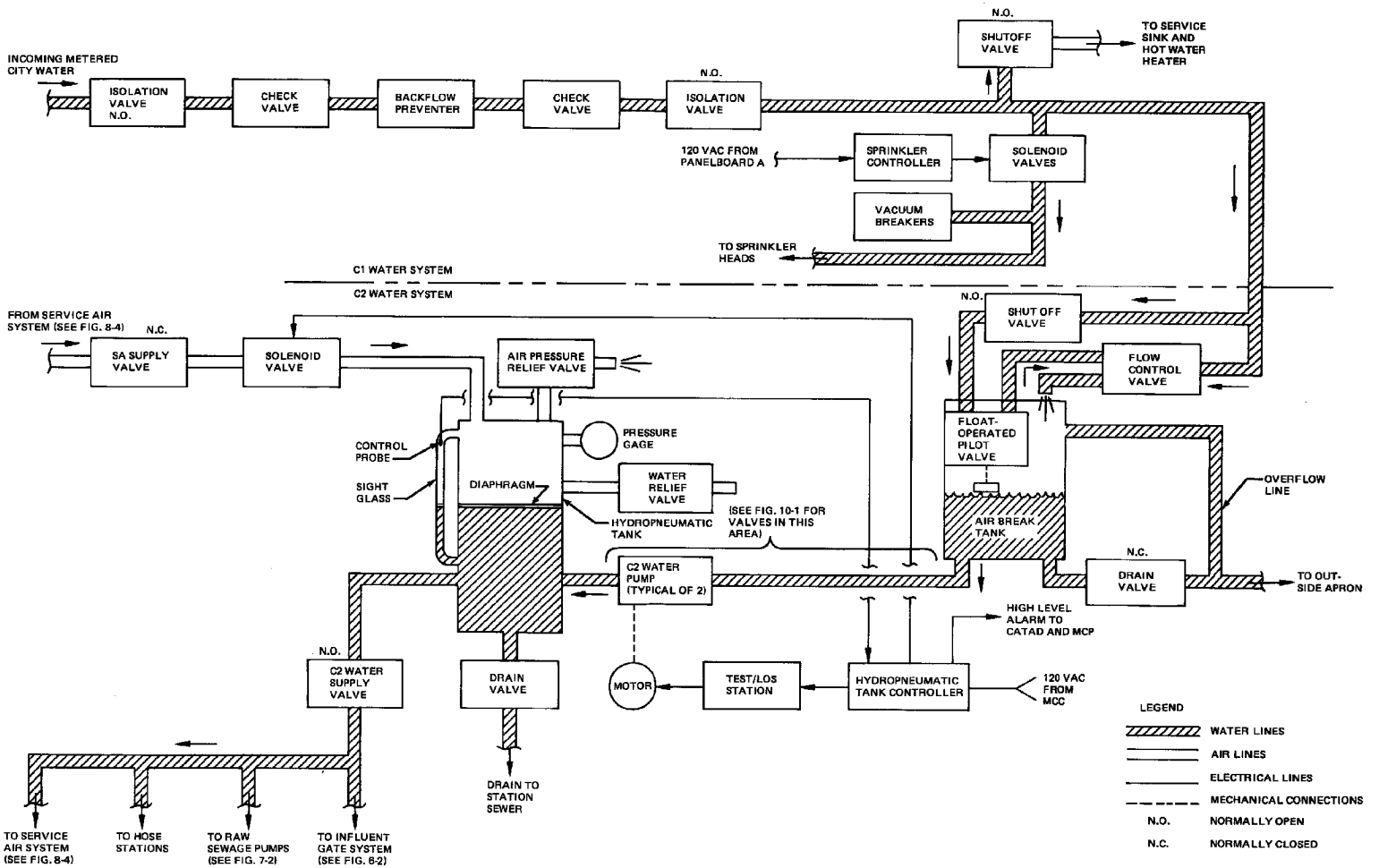


Figure 10-2. C1 and C2 Water Systems Functional Diagram

ALARM INDICATIONS

Water systems alarm indications and corrective action are listed in table 10-2.

OPERATOR SERVICES

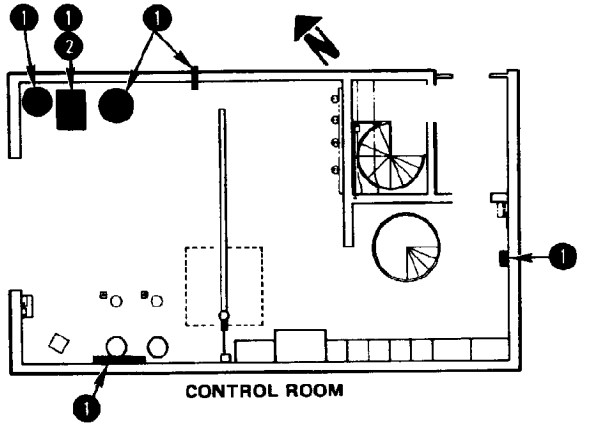
Periodic operator-performed services and checks are listed in table 10-3. An illustration at the end of the table shows where each service is performed.

Table 10-2. Water Systems Alarm Indications

ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
C2 WATER SYSTEM (AL 6)	C2 Low Water Pressure Switch PS 114	C2 water system pressure at or below 25 psi (1.8 kg/sq cm)	**Note** *To quickly determine cause, check hydropneumatic tank pressure gage; then tank sight glass.* Check duty C2 water pump to make sure it is operating (pump selector must be on 1 or 2; center position locks out both pumps); if not, check motor controller D2 for tripped breaker. Alternate pumps; if new duty pump maintains load, notify supervisor that a pump is defective. If pumps operate correctly, check for excessive leakage in C2 system. Check for air leaks from hydropneumatic tank. Effect temporary repairs, if possible, and notify supervisor. Log all actions in station log.
	Control probe in hydropneumatic tank water level sight glass	Hydropneumatic tank water level at or above elevation 119.5 (water depth 43 in. or 1.1 m)	Perform tank air charging procedure (table 10-6). **Note** *High hydropneumatic tank water level indicates excessive diffusion of air into the water around the edges of the tank diaphragm.*

Table 10-3. C1 and C2 Water Systems Operator Services

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
WEEKLY			
1. Visually inspect C1 and C2 water systems.	1. No obvious leakage or damage.	1. Leakage or damage.	1. Repair, if possible. Notify supervisor and record action in station log.
2. At C2 Water Pumps:			
2a. Test run pump in service.	2a. Quiet, smooth operation.	2a. Unusual noise or excessive vibration.	2a. Notify supervisor and record action in station log.
2b. Check pump mechanical seal for leakage.	2b. No leakage.	2b. Leakage.	2b. Record condition in station log and notify supervisor.
2c. Place pump selector to 1 or 2 as required and repeat steps 2a and 2b for other pump.	2c. Same as 2a and 2b.	2c. Same as 2a and 2b.	2c. Same as 2a and 2b.
Note *Center position on pump selector locks out both pumps.*	**Note** *Pump No. 2 normally operates for 2 weeks; pump No. 1 for 1 week.*		



OPERATING PROCEDURES

Operating procedures for the C1 and C2 water systems include C2 water pump operation (table 10-4), irrigation sprinkler operation (table 10-5), and hydropneumatic tank air charging (table 10-6).

Table 10-4. C2 Water Pump Operation

PROCEDURES

Startup

1. At MCC, place (or verify) circuit breaker on C2 WATER PUMPS motor controller D2 to ON. READY (green) indicator comes (is) on.

2. At pumps, select unit for service by placing pump selector to 1 or 2.

Note

The pump selector has three positions: 1, center, and 2. Center position locks out both pumps.

Testing

1. At pumps, select unit to be tested by placing pump selector to 1 or 2.

2. At WATER SEAL PUMP (C2 Water Pump) manual control station, press and hold TEST pushbutton. Pump runs as long as pushbutton is depressed.

Table 10-5. Irrigation Sprinkler Operation

PROCEDURES

CAUTION

Always place master switch to OFF before setting controls.

Fully Automatic Operation

1. Turn on sprinkler water and electrical supplies.

Table 10-5. Irrigation Sprinkler Operation (Cont.)

Note

The following steps are performed at the irrigation control panel on the southeast wall of the control room.

CAUTION

When rotating clock dial, time dial may engage. If this occurs, rotate time dial slowly clockwise until gear clicking stops.

2. Rotate clock dial clockwise to set correct time under TIME arrow.

3. Install tabbed trippers on 3-hour time dial beneath clock dial. This determines how long each sprinkler station will be active during a sprinkler cycle. Secure all seven trippers on dial perimeter.

4. Install untabbed trippers in clock dial at times sprinkling cycle is to start. Tighten securely.

5. Rotate DAY PROGRAM dial counterclockwise and set today's initial under pointer. Insert screws at days watering is desired.

6. Rotate STATION SELECTOR to OFF.

7. Place each of the seven STATIONS switches to WATER or OMIT, as desired.

Note

Place unused STATION switches to OMIT, also. The STATION switch includes or removes its associated sprinkler from the watering cycle. An omitted station may water briefly.

8. Place master switch to AUTO.

Semiautomatic Operation

1. Place master switch to MANual.

2. Rotate 3-hour time dial until station 1 trips at STATION arrow to start automatic cycle.

Table 10-5. Irrigation Sprinkler Operation (Cont.)

3. When watering is complete, place master switch to AUTO or OFF.

Note

If master switch is left in MANual, watering will recur per automatic programming.

Manual Operation

1. Rotate STATION SELECTOR counterclockwise to desired station.

2. Place master switch to MANual.

3. Set time dial for 5 or more minutes. Station sprinkler will turn on and remain on until another station is selected manually.

4. When watering is complete, place STATION SELECTOR to OFF and master switch to AUTO or OFF. See "Note" after "Semiautomatic Operation".

COMMENT

The station operator sets the irrigation controller watering pattern as instructed by the gardener or supervisor.

Table 10-6. Hydropneumatic Tank Air Charging

This procedure is performed when the hydropneumatic tank water level has risen to a water depth of 43 inches (1.1 m) or elevation 119.5 and triggered alarm AL 6. High tank water level indicates excessive diffusion of air into water around the edges of the tank diaphragm. Consequently, air pressure dissipates and the C2 water pump operates more and more frequently to maintain subsystem pressure.

PROCEDURE

1. At C2 WATER SEAL PUMP (C2 water pump) manual control station, press and latch STOP pushbutton.

2. At hydropneumatic tank, open service air supply valve.

3. Inside hydropneumatic tank control panel, place ADD AIR/RUN switch to ADD AIR.

4. At hydropneumatic tank, open drain valve. Empty tank until water level drops to high level mark on sight glass.

5. Close tank drain and C2 water supply valves.

6. At pump manual control station, unlatch STOP pushbutton. With C2 water supply valve closed, unlatching pump STOP pushbutton energizes service air admission solenoid valve inside hydropneumatic tank control panel to let air into tank.

7. When tank pressure reaches 100 psi (7 kg/sq cm), air supply is automatically shut off. When this occurs, place ADD AIR/RUN switch to RUN.

8. Open tank C2 water supply valve.

9. Check tank sight glass. Water level should be between high and low level marks.

DRAINAGE SYSTEM

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SECTION XI
DRAINAGE SYSTEM

PHYSICAL DESCRIPTION

The drainage system consists of sump and storm drainage subsystems. The sump drainage subsystem collects wastewater from pump room floor and equipment drains and discharges it through a force main into the station 6-inch (168-mm) sanitary sewer. The sanitary sewer also collects wastewater from control room equipment and floor drains, the restrooms, and the service sink and transports it to the overflow manhole east of the station. The storm drainage subsystem is a gravity network that collects stormwater from the station roof and apron. It discharges it into the storm drain manhole, also east of the station beyond the overflow manhole (see figure 1-5), through an 8-inch (219-mm) line.

The pump room sump, next to raw sewage pump No. 3, is about 3 feet (0.9 m) in diameter and 6 feet (1.8 m) deep and contains a single submersible pump. In the pump discharge line are a flushing cock, check valve, and plug valve. The discharge line connects to the station sanitary sewer at a wye about 5 feet (1.5 m) outside the control room southeast wall and 10 feet (3.0 m) from the south corner of the building. The sump pump control circuit consists of the sump bubbler, level indicator/controller LIC 104C, the TEST/STOP-lockout control station, and pump room flood drain float switch FS 117. Power is supplied to the sump pump through MCC compartment A3. Figure 11-1 illustrates sump drainage subsystem components; table 11-1 lists equipment characteristics.

FUNCTIONAL DESCRIPTION

Power from the 460-volt MCC bus is routed to the sump pump motor (figure 11-2) through the circuit breaker on MCC motor controller A3. Level controller LIC 104C automatically operates the sump pump and triggers alarms in response to bubbler tube signals as follows:

FUNCTIONS	SUMP DEPTH Feet (Meters)	ELEVATION
Sump Overflow	6.1 (1.9)	91.60
SUMP HIGH LEVEL alarm (AL 5)	5.5 (1.7)	91.00
Sump Pump On	4.5 (1.4)	90.00
Alarm Cancel (Manual Reset)	2.5 (0.8)	88.00
Sump Pump Off	2.0 (0.6)	87.50
Sump Invert	0.0	85.50

If the sump depth increases faster than the pump can expel the water, the excess overflows into the pump room. When 3 inches (76 mm) of water accumulates in the pump room, float switch FS 117 (next to the sump) triggers PUMP ROOM FLOOD alarm AL 2 at the MCP annunciator, alerts the CATAD control facility, and transmits a Metrotel priority 1 alarm to the WPTP.

Note

Pump room flooding may also be caused by leaking raw sewage pumps, force mains, or seal water manifolds (see table 11-2).

ALARM INDICATIONS

Table 11-2 lists alarm indications and the required corrective action.

OPERATOR SERVICES

Periodic operator-performed sump drainage system services and checks are described in table 11-3. An illustration at the end of the table shows where each service is performed.

OPERATING PROCEDURES

The sump drainage system normally operates automatically. The circuit breaker at MCC motor controller A3 remains on at all times. If necessary, the operator may shut down the pump by opening the circuit breaker. During maintenance, the pump should be shut down and locked out at the local control station and its circuit breaker at the MCC should be open, locked out, and tagged. To test run the pump, check that its circuit breaker is closed (ON), then press and hold the TEST pushbutton at the local control station. The pump stops when the pushbutton is released.

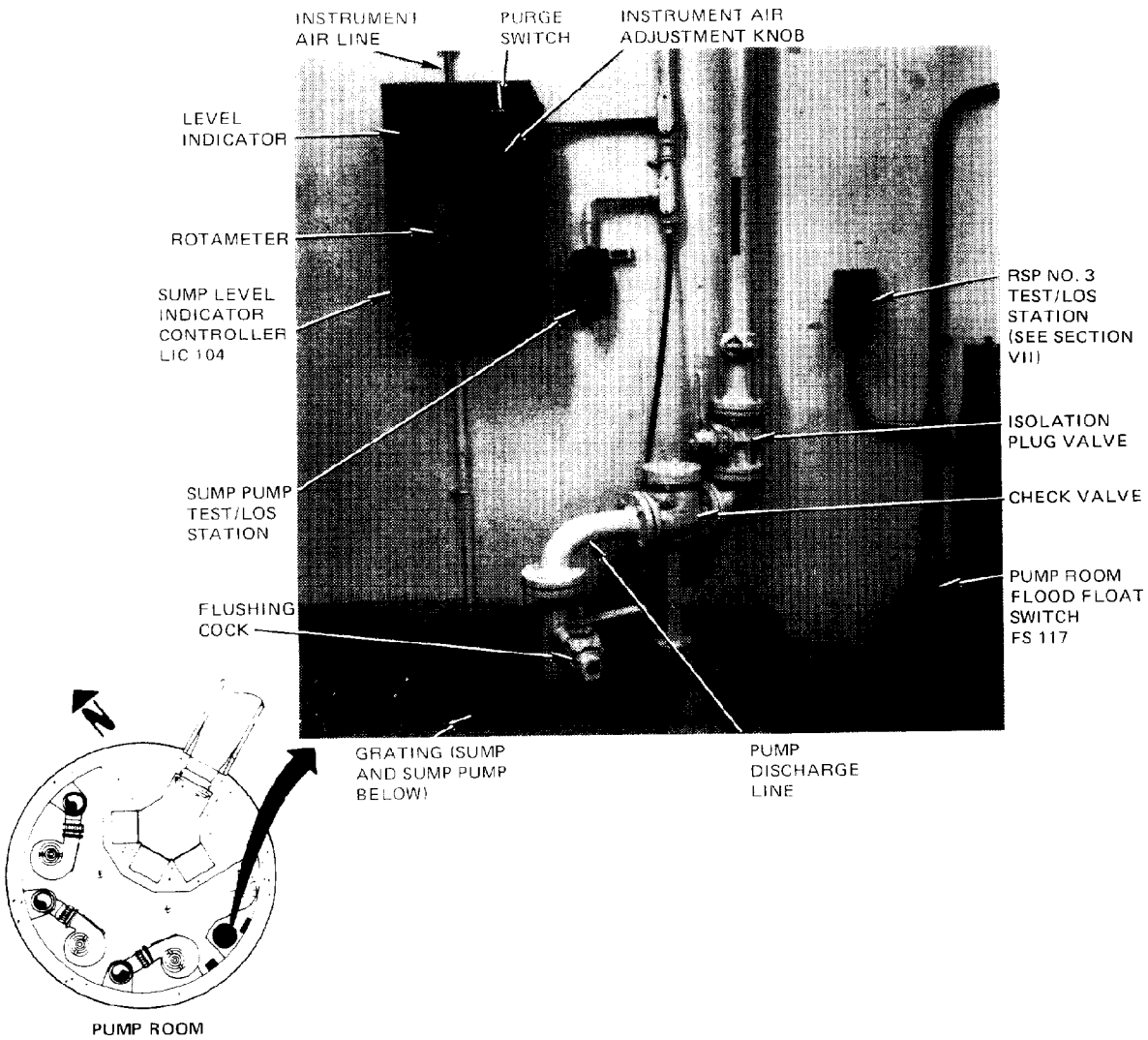


Figure 11-1. Sump Drainage System Equipment

Table 11-1. Sump Drainage System Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
Sump Pump		Wemco, model 3S2 torque-flow pump; capacity – 50 gpm (0.19 cu m/min) at 30 feet (9.1 m) total dynamic head
Motor		U.S. Electrical Motors, Inc., Universe model; rating – 3 hp (2.2 kw) at 1,735 rpm, 60 Hz, 3-phase, 460 V
Sump Level Indicator Controller	LIC 104C	Foxboro Company, Rotex pressure controller; input-bubbler back-pressure signal; output – 3 to 15 psi (0.2 to 1.0 kg/sq cm); supply pressure 20 psi (1.5 kg/sq cm); range – 0 to 5 feet (1.5 m) water
Pump Room Flood Float Switch	FS 117	Crouse-Hinds Co., model 0S-100-6

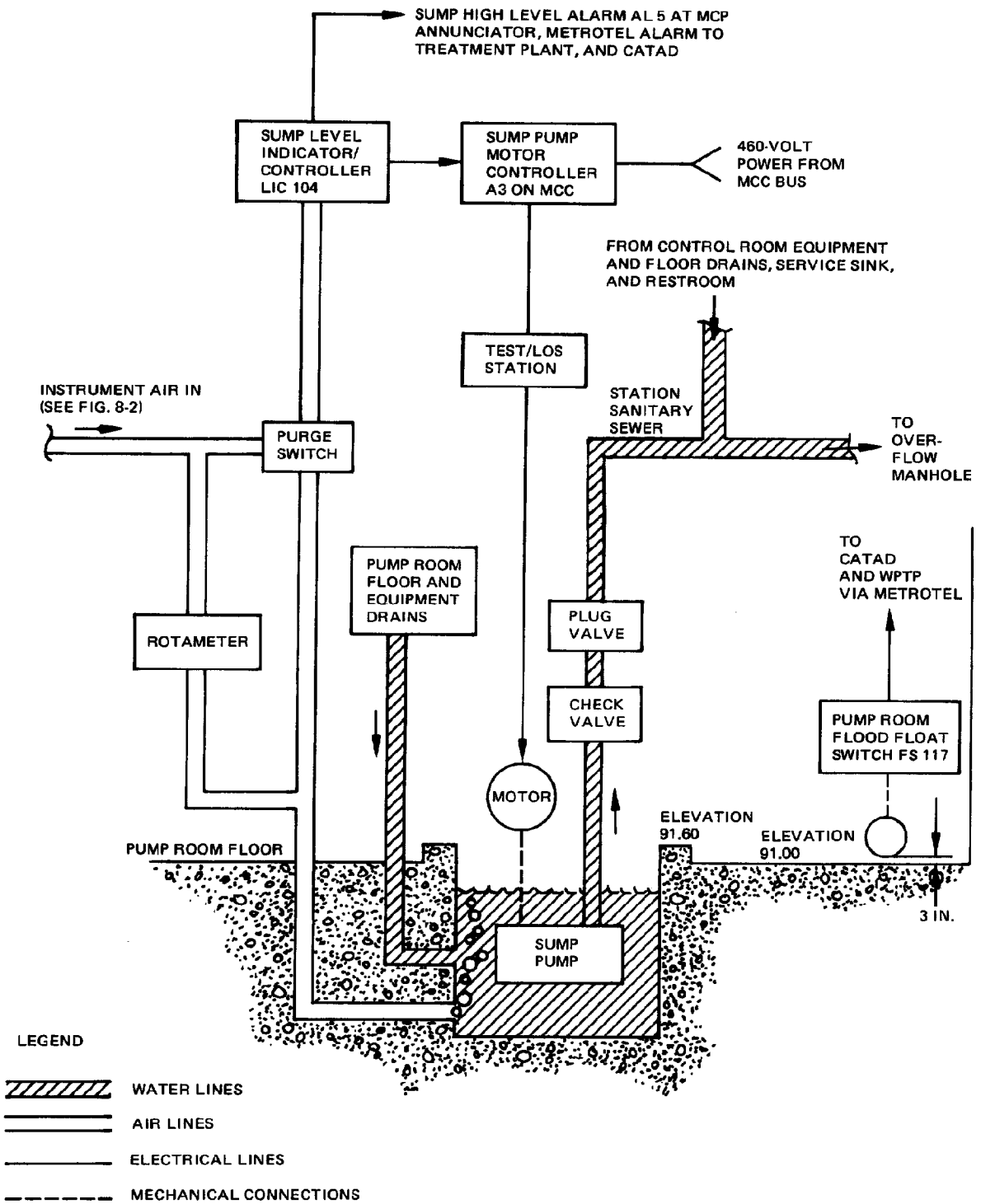


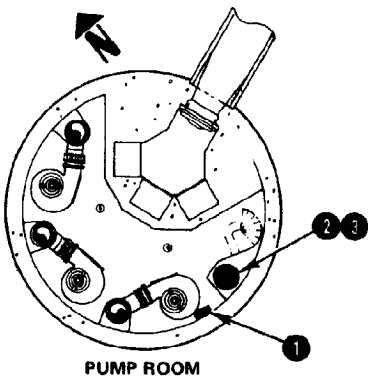
Figure 11-2. Sump Drainage System Functional Diagram

Table 11-2. Sump Drainage System Alarm Indications

ALARM/FAULT	SENSOR	ACTUATION POINT	CORRECTIVE ACTION
AT MCP ANNUNCIATOR:			
SUMP HIGH LEVEL (AL 5)	LIC 104C	Sump depth of 5.5 feet (1.7 m)	Check sump pump motor controller. If pump is operating, inspect building and equipment drains for possible excessive drainage. If sump pump is inoperative, check bubbler tube air supply by observing rotameter. If low air flow is noted, operate purge switch. If air flow is still low, check instrument air system (Section VIII). Finally, test pump operation at local control stations. If fault persists, notify supervisor. Record condition and action taken in station log.
PUMP ROOM FLOOD (AL 2)	Float Switch FS 117	3 inches (76 mm) of water on pump pump room floor	Inspect pump room to determine cause of flooding. If sump pump is inoperative, secure portable sump pump and pump wastewater into wet well. Troubleshoot and repair sump pump or pump control circuit. If leaking raw sewage pumps or force main mains are causing flooding, refer to Section VII of this manual. Notify supervisor and record condition and action taken in station log. **Note** *After alarm problems have been resolved, press alarm RESET pushbutton to clear annunciator panel.*

Table 11-3. Sump Drainage System Operator Services

ITEM AND CHECK/FUNCTION	NORMAL INDICATION	ABNORMAL CONDITION	
		INDICATION	ACTION
DAILY			
1. At Level Controller LIC 104:			
1a. Check rotameter adjustment.	1a. 0.8 scfh (0.02 scu m/hr).	1a. Other than normal.	1a. See step 1b.
1b. Purge bubbler.	– – –	– – –	– – –
1c. Adjust rotameter for 0.8 scfh (0.02 scu m/hr).	1c. Float ball bounces and settles at proper setting.	1c. Other than normal.	1c. Check instrument air system (Section VIII) for proper operation.
2. At Sump:			
2a. Test run sump pump and observe operation of check valve.	2a. Pump runs without excessive noise or vibration and pumps effectively.	2a. Pump noisy, vibrates excessively, or does not pump effectively.	2a. Notify supervisor and record action in station log.
WEEKLY			
3. At Sump:			
3a. Using TEST pushbutton at local control station, pump down sump to top of pump.	3a. Pump runs without excessive noise or vibration and pumps effectively.	3a. Pump noisy, vibrates excessively, or does not pump effectively.	3a. Notify supervisor and record action in station log.
3b. Wash down sump.	– – –	– – –	– – –
QUARTERLY			
4. Check and clean all station roof drains and catch basins.	– – –	– – –	– – –



PUMP ROOM

HOISTING EQUIPMENT

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SECTION XII
HOISTING EQUIPMENT

INTRODUCTION

Hoisting equipment is located throughout the station (figure 12-1) to facilitate equipment installation and removal. Table 12-1 lists equipment characteristics.

PHYSICAL DESCRIPTION

In the control room is a chain hoist-trolley on an overhead monorail. The monorail is directly over the motor room access hatch and extends almost the width of the control room. A power cable reel [capacity – 25 feet (7.6 m)] is mounted at the southwest end of the monorail.

The hoist is equipped with a safety hook, overload protection, motor and load brakes, a hook travel limiter, and a pendant control station. Power is supplied to the hoist motor through motor control section A1A.

In the motor room are three monorails, one over each sewage pump drive unit. A trolley, from which a chain hoist may be suspended, is transferred from one rail to another as needed. Lifting eyes, convenient for chain hoist use, are installed above equipment in the pump room.

A fourth monorail, with trolley, is suspended from lifting eyes in the wet well and facilitates movement of pump inlet slide gates and the bar screen.

FUNCTIONAL DESCRIPTION

The control room hoist is electrically operated. During lowering, a self-actuating mechanical load brake controls the rate of descent; the rate decreases from maximum at no load to minimum at maximum load. A solenoid-operated motor brake controls hook drift, facilitates spotting of loads, and locks the hoist motor drive shaft when the motor is off. A load limiter prevents equipment damage from overloads or chain jamming, and acts automatically to limit the vertical travel of the load block and hook during raising and lowering. Upper and lower limit switches also restrict vertical travel of the load block and hook.

All hoist trolleys are positioned by pulling the attached hoist along the monorail.

OPERATOR SERVICES

There are no hoisting equipment alarms or operator-performed adjustments. However, once a month, exercise the control room hoist (table 12-1) and check the unit for the following:

1. All control and operating mechanisms for proper operation.

2. Operation of limit switches under no-load conditions.

3. Worn or frayed wires and loose connections.

4. Hook for cracks or deformation; ensure that hook swivels freely.

5. Wire rope for kinks, crimps, unstranding, wear, broken wires, and broken end connections.

6. The load brakes for worn disk, broken or stretched panel springs. Report any discrepancies to your supervisor.

OPERATING PROCEDURES

Hoisting equipment operating procedures are listed in table 12-2.

WARNING

DO NOT *Lift more than the rated load.*

Lift people or loads over people.

Operate with twisted, kinked or damaged chain.

Operate damaged or malfunctioning hoisting.

Operate hoist when hook is not centered under hoist.

Operate unless travel limit devices function. Test before using.

Remove or obscure warning label on pendant control station (control room hoist only).

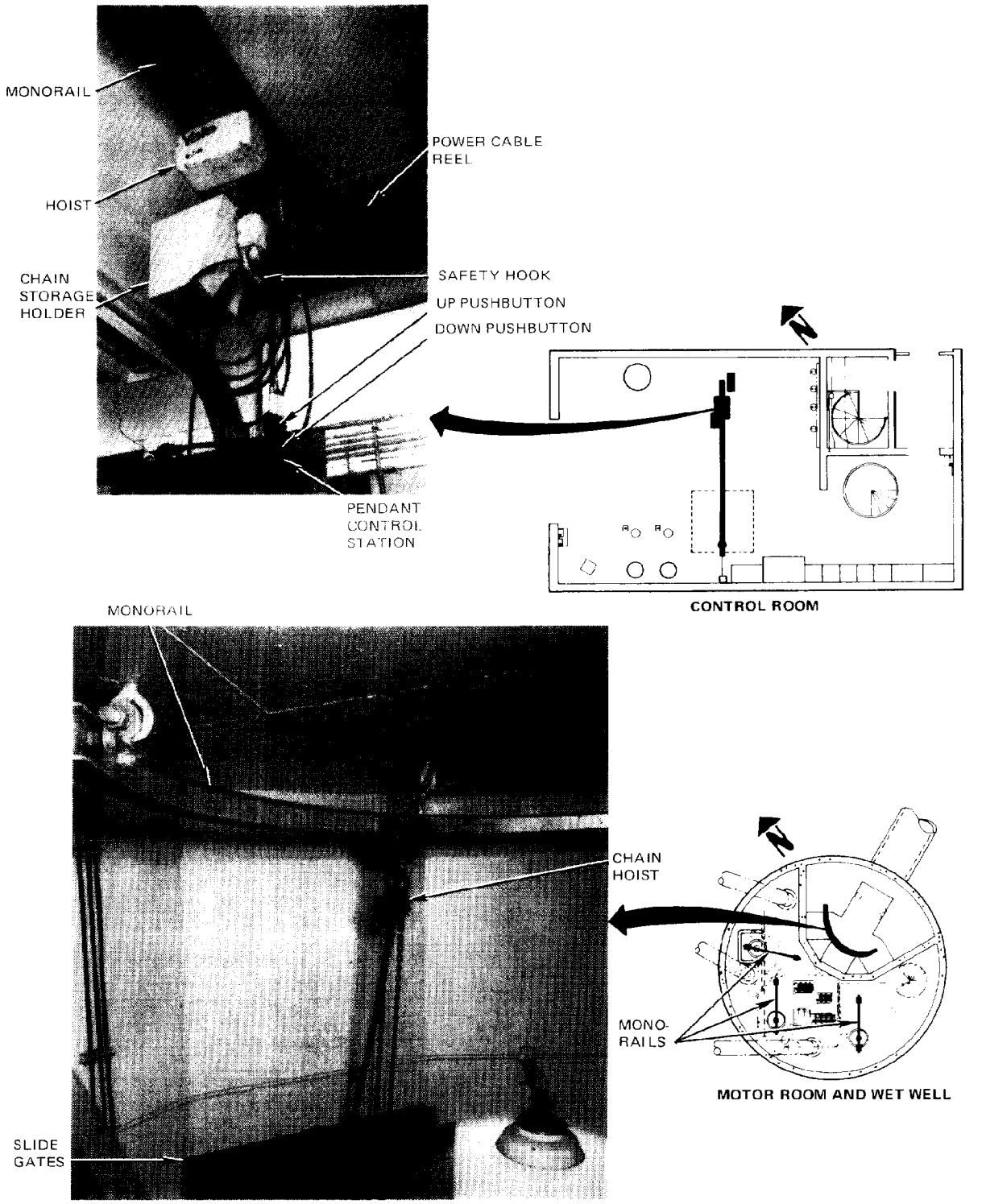

Figure 12-1. Hoisting Equipment

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Table 12-1. Hoisting Equipment Characteristics

COMPONENT	METRO NUMBER	CHARACTERISTICS
Control Room Chain Hoist Trolley		Eaton Corporation, Yale model KEL-2-31P71/2S2 plain trolley type; capacity – 2 tons (1,800 kg); lift – 31 feet (9.5 m); hoisting speed – 7.5 feet (2.3 m) per minute; motor rating – 1 hp (0.75 kw), 60 Hz, 3-phase, 460 V
Motor Room Trolley		Eaton Corporation, Yale model FW hand trolley, product code 00404; capacity – 2 tons (1,800 kg)
Wet Well Trolley and Chain Hoist		(To be supplied)

Table 12-2. Hoisting Equipment Operating Procedures

PROCEDURE

Control Room Hoist

1. At MCC compartment A1A, place MONORAIL HOIST circuit breaker to ON.

2. At hoist pendant control station, press UP or DOWN pushbutton. Hold pushbutton during entire time of travel.

3. When finished, return load block and hook to fully raised position. If equipment is to be inoperative for an extended period, place MONORAIL HOIST circuit breaker to OFF.

Trolleys

To position trolleys, pull along monorail by hoist pendant chain.

APPENDIX A — GLOSSARY

APPENDIX A
GLOSSARY

Part I

This section of the glossary contains wastewater terms and definitions regularly used or having special meaning in Metro wastewater operations. The terms and definitions have been extracted from "Glossary, Water and Wastewater Control Engineering" and edited to fit Metro requirements. The complete referenced glossary is readily available at the central office library or the major treatment plants.

ACTIVATED SLUDGE–Sludge floc produced in raw or settled wastewater by the growth of zoogleal bacteria and other organisms in the presence of dissolved oxygen and accumulated in sufficient concentration by returning floc previously formed.

ACTIVATED SLUDGE LOADING–The pounds of biochemical oxygen demand (BOD) in the applied liquid per unit volume of aeration capacity or per pound of activated sludge per day.

ACTIVATED SLUDGE PROCESS–A biological wastewater treatment process in which a mixture of wastewater and activated sludge is agitated and aerated. The activated sludge is subsequently separated from the treated wastewater (mixed liquor) by sedimentation and wasted or returned to the process as needed.

AERATION–(1) The bringing about of intimate contact between air and a liquid by one or more of the following methods: (a) spraying the liquid in the air, (b) bubbling air through the liquid, (c) agitating the liquid to promote surface absorption of air. (2) The supplying of air to confined spaces under nappes, downstream from gates in conduits, etc., to relieve low pressure and to replenish air entrained and removed from such confined spaces by flowing water. (3) Relief of the effects of cavitation by admitting air to the section affected.

AERATION TANK–A tank in which sludge, wastewater, or other liquid is aerated.

AEROBIC–Requiring, or not destroyed by the presence of free elemental oxygen.

AEROBIC BACTERIA–Bacteria that require free elemental oxygen for their growth.

AEROBIC DIGESTION–Digestion of suspended organic matter by means of aeration. See digestion.

AIR-BOUND–Obstructed, as to the free flow of water, because of air entrapped in a high point; used to describe a pipeline or pump in such condition.

AIR GAP (BREAK) SEPARATION–The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or outlet supplying water to a tank, plumbing fixture, or other device, and the flood-level rim of the receptacle.

ANAEROBIC–Requiring, or not destroyed by, the absence of air or free elemental oxygen.

ANAEROBIC BACTERIA–Bacteria that grow only in the absence of free elemental oxygen.

ANAEROBIC CONTACT PROCESS–An anaerobic waste treatment process in which the microorganisms responsible for waste stabilization are removed from the treated effluent stream by sedimentation or other means and held in or returned to the process to enhance the rate of treatment.

ANAEROBIC DIGESTION–The degradation of organic matter brought about through the action of microorganisms in the absence of elemental oxygen.

AVERAGE DAILY FLOW–The total quantity of liquid tributary to a point divided by the number of days of flow measurement.

AVERAGE FLOW–Arithmetic average of flows measured at a given point.

AXIAL-FLOW PUMP–A type of centrifugal pump which develops most of its head by the propelling or lifting action of the vanes on the liquids. Also called propeller pump.

BACKFLOW–(1) A flow condition, induced by a differential in pressure, that causes the flow of water or other liquid into the distribution pipes of a potable water supply from any source or sources other than its intended source. (2) The backing up of water through a conduit or channel in the direction opposite to normal flow.

BACKFLOW CONNECTION–In plumbing, any arrangement whereby backflow can occur. Also called interconnection, cross connection. See backflow.

BACKFLOW PREVENTER–A device for a water supply pipe to prevent the backflow of water into the water supply system from the connections on its outlet end. Also see vacuum breaker.

BACKSIPHONAGE–A form of backflow caused by a negative or subatmospheric pressure within a water system. See backflow.

BIOCHEMICAL OXIDATION–An oxidation brought about by biological activity which results in chemical combination of oxygen with organic matter.

BIOCHEMICAL OXYGEN DEMAND–A standard test used in assessing wastewater strength. See BOD.

BLEED–To drain a liquid or gas, as to bleed accumulated air from a water line or to drain a trap or a container of accumulated water.

BOD–(1) Abbreviation for biochemical oxygen demand. The quantity of oxygen used in the biochemical oxidation of organic matter in a specified time, at a specified temperature, and under specified conditions. (2) A standard test used in assessing wastewater strength.

BOD LOAD–The BOD content, usually expressed in pounds per unit of time, of wastewater passing into a waste treatment system or to a body of water.

BOOSTER PUMP–A pump installed on a pipeline to raise the pressure of the water on the discharge side of the pump.

BOOSTER STATION–A pumping station in a water distribution system that is used to increase the pressure in the mains on the discharge side of the pumps.

BRANCH SEWER–A sewer that receives wastewater from a relatively small area and discharges into a main sewer serving more than one branch-sewer area.

BUILDING DRAIN–In plumbing, part of the lowest horizontal piping of a drainage system that receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer (house sewer). The latter begins 5 feet outside the inner face of the building wall.

BUILDING DRAINAGE SYSTEM–In plumbing, all piping provided for carrying wastewater or other drainage from the building to the street sewer or place of disposal.

BUILDING SEWER–In plumbing, the extension from the building drain to the public sewer or other place of disposal. Also called house connection.

BUILDING STORM SEWER–The extension from the building storm drain to the public storm sewer, combined sewer, or other place of disposal.

BUILDING SUBDRAIN–In plumbing, that portion of a drainage system that cannot drain by gravity into the building sewer. Also called house subdrain.

BUILDING TRAP–In plumbing, a running trap installed in the building drain to prevent a free circulation of air between the drainage system of the building and the building sewer. Also called house trap.

BUTTERFLY GATE–A gate that opens like a damper turning on a shaft inside the pipe. Similar to butterfly valve.

BUTTERFLY VALVE–A valve wherein the disk, as it opens or closes, rotates about a spindle supported by the frame of the valve. The valve is opened at a stem. At full opening, the disk is in a position parallel to the axis of the conduit.

BYPASS–An arrangement of pipes, conduits, gates, and valves whereby the flow may be passed around a hydraulic structure or appurtenance.

CAVITATION–The formation of a cavity between the downstream surface of a moving body, for example, the blade of a propeller, and a liquid normally in contact with it.

CENTRIFUGAL DEWATERING OF SLUDGE–The partial removal of water from wastewater sludge by centrifugal action.

CENTRIFUGAL PUMP–A pump consisting of an impeller fixed on a rotating shaft and enclosed in a casing, and having an inlet and a discharge connection. The rotating impeller creates pressure in the liquid by the velocity derived from centrifugal force.

CHECK VALVE–A valve provided with a disk hinged on one edge so that it opens in the direction of normal flow and closes with reversal of flow. An approved check valve is of substantial construction and suitable materials, is positive in closing, and permits no leakage in a direction opposite to the normal flow.

CHEMICAL OXYGEN DEMAND (COD)–A measure of the oxygen-consuming capacity of inorganic and organic matter present in water or wastewater. It is expressed as the amount of oxygen consumed from a chemical oxidant in a specific test. It does not differentiate between stable and unstable organic matter and thus does not necessarily correlate with biochemical oxygen demand. Also known as OC and DOC, oxygen consumed and dichromate oxygen consumed, respectively.

CHLORINATION–The application of chlorine to water or wastewater, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

CHLORINE CONTACT CHAMBER–A detention basin provided primarily to secure the diffusion of chlorine through the liquid. Also called chlorination chamber.

CHLORINE DEMAND–The difference between the amount of chlorine added to water or wastewater and the amount of residual chlorine remaining at the end of a specified contact period. The demand for any given water varies with the amount of chlorine applied, time of contact, and temperature. See residual chlorine.

CIPOLLETTI WEIR–A contracted weir of trapezoidal shape, in which the sides of the notch are given a slope of one horizontal to four vertical to compensate as much as possible for the effect of end contractions.

CLOSE-COUPLED PUMP–A pump directly connected to its power unit without any reduction gearing or shafting.

COMBINED SEWER–A sewer intended to receive both wastewater and storm or surface water.

COMBINED WASTEWATER–A mixture of surface runoff and other wastewater such as domestic or industrial wastewater.

COMMINUTION–The process of cutting and screening solids contained in wastewater flow before it enters the flow pumps or other units in the treatment plant.

CONTACT STABILIZATION PROCESS–A modification of the activated sludge process in which raw wastewater is aerated with a high concentration of activated sludge for a short period, usually less than 60 minutes, to obtain BOD removal by absorption. The solids are subsequently removed by sedimentation and transferred to a stabilization tank where aeration is continued further to oxidize and condition them before their reintroduction to the raw wastewater flow.

CONTAMINATION–Any introduction into water of microorganisms, chemicals, wastes, or wastewater in a concentration that makes the water unfit for its intended use.

CONTINUOUS-FLOW PUMP–A displacement pump within which the direction of flow of the water is not changed or reversed.

CROSS CONNECTION–(1) A physical connection through which a supply of potable water could be contaminated or polluted. (2) A connection between a supervised potable water supply and an unsupervised supply of unknown potability.

DECHLORINATION–The partial or complete reduction of residual chlorine in a liquid by any chemical or physical process.

DECOMPOSITION OF WASTEWATER–(1) The breakdown of organic matter in wastewater by bacterial action, either aerobic or anaerobic. (2) Transformation of organic or inorganic materials contained in wastewater through the action of chemical or biological processes.

DEPRESSED SEWER–A section of sewer constructed lower than adjacent sections to pass beneath a valley, watercourse, or other obstruction. It runs full or at pressure greater than atmospheric because its crown is depressed below the hydraulic grade line. See inverted siphon.

DEWATER–(1) To extract a portion of the water present in a sludge or slurry. (2) To drain or remove water from an enclosure. A riverbed may be dewatered so that a dam can be built in the dry; a structure may be dewatered so that it can be inspected or repaired.

DIFFUSER–A porous plate, tube, or other device through which air is forced and divided into minute bubbles for diffusion in liquids. Commonly made of carborundum, alundum, metal, or plastic materials.

DIGESTED SLUDGE–Sludge digested under either aerobic or anaerobic conditions until the volatile content has been reduced to the point at which the solids are relatively nonputrescible and inoffensive.

DIGESTER–A tank in which sludge is placed to permit digestion to occur. Also called sludge digestion tank. See sludge digestion.

DIGESTION–(1)The biological decomposition of organic matter in sludge, resulting in partial gasification, liquefaction, and mineralization. (2) The process carried out in a digester. See sludge digestion.

DISSOLVED OXYGEN–The oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation. Abbreviated DO.

DISSOLVED SOLIDS–Theoretically, the anhydrous residues of the dissolved constituents in water. Actually, the term is defined by the method used in determination. In water and wastewater treatment the Standard Methods tests are used.

DIVERSION GATE–(1) A gate, with one of many forms, that may be closed to divert flow from the channel in which it is located to some other channel. (2) A gate in an irrigation or other conduit or canal that divides the flow therein between two or more laterals.

DRY-WEATHER FLOW–(1) The flow of wastewater in a combined sewer during dry weather. Such flow consists mainly of wastewater, with no storm water included.

EFFLUENT–(1) A liquid which flows out of a containing space. (2) Wastewater or other liquid, partially or completely treated, or in its natural state, flowing out of a

reservoir, basin, treatment plant, or industrial treatment plant, or part thereof.

FINAL EFFLUENT–The effluent from the final treatment unit of a wastewater treatment plant.

FLAP GATE–A gate that opens and closes by rotation around a hinge or hinges at the top side of the gate.

FLOAT SWITCH–An electrical switch operated by a float in a tank or reservoir and usually controlling the motor of a pump.

FLOCCULATION–In water and wastewater treatment, the agglomeration of colloidal and finally divided suspended matter after coagulation by gentle stirring by either mechnical or hydraulic means. In biological wastewater treatment where coagulation is not used, agglomeration may be accomplished biologically.

FLOTATION–The raising of suspended matter to the surface of the liquid in a tank as scum–by aeration, the evolution of gas, chemicals, electrolysis, heat, or bacterial decomposition–and the subsequent removal of the scum by skimming.

FLUSHING–(1) The removing of deposits of material which have lodged in conduits, sewers, or tanks because of inadequate velocity of flow. Water or wastewater is discharged into the conduits at such rates that the larger flow and higher velocity are sufficient to remove the material.

FORCE MAIN–A pressure pipe joining the pump discharge at a water or wastewater pumping station with a point of gravity flow.

HEAD–(1) The height of the free surface of a fluid above any point in a hydraulic system; a measure of the pressure or force exerted by the fluid. (2) The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed. It is used in various compound terms such as pressure head, velocity head, and loss of head.

INDUSTRIAL WASTES–The liquid wastes from industrial processes, as distinct from domestic or sanitary wastes.

INFLUENT–Water, wastewater, or other liquid flowing into a reservoir, basin, or treatment plant, or any unit thereof.

INTERCEPTING SEWER (INTERCEPTOR)–A sewer that receives dry-weather flow from a number of transverse sewers or outlets and frequently additional predetermined quantities of storm water (if from a combined system), and conducts such waters to a point for treatment or disposal.

INTERCEPTION–In waste collection, the process of diverting wastewater from a main or a trunk into a conduit carrying flow to a treatment plant, usually found as part of a system for diverting the flow from a combined sewer.

INVERT–The floor, bottom, or lowest portion of the internal cross-section of a closed conduit. Used particularly with reference to aqueducts, sewers, tunnels, and drains. Originally, it referred to the inverted arch which was used to form the bottom of a masonry-lined sewer.

INVERTED SIPHON–A pipeline crossing a depression or passing under a structure and having a reversal in grade on a portion of the line, thus creating a V- or U- shaped section of conduit. The line is under positive pressure from inlet to outlet and should not be confused with a siphon. Also called depressed sewer.

LATERAL SEWER–A sewer that discharges into a branch or other sewer and has no other common sewer tributary to it.

LIFT STATION (PUMPING STATION)–A small wastewater pumping station that lifts the wastewater to a higher elevation when the continuance of the sewer at reasonable slopes would involve excessive depths of trench, or that raises wastewater from areas too low to drain into available sewers. These stations may be equipped with pneumatic ejectors or centrifugal pumps.

MAIN SEWER–In larger systems, the principal sewer to which branch sewers and submains are tributary; also called trunk sewer. In small systems, a sewer to which one or more branch sewers are tributary.

MECHANICAL AERATION–(1) The mixing, by mechanical means, of wastewater and activated sludge in the aeration tank of the activated sludge process to bring fresh surfaces of liquid into contact with the atmosphere. (2) The introduction of atmospheric oxygen into a liquid by the mechanical action of paddle, paddle wheel, spray, or turbine mechanisms.

MILLIGRAMS PER LITER–A unit of the concentration of water or wastewater constituent. It is 0.001 g of the constituent in 1,000 ml of water. It has replaced the unit formerly used commonly, parts per million, to which it is approximately equivalent, in reporting the results of water and wastewater analysis.

MIXED LIQUOR–A mixture of activated sludge and organic matter undergoing activated sludge treatment in the aeration tank.

ODOR CONTROL–In wastewater treatment, the prevention or reduction of objectionable odors by chlorination,

aeration, or other processes or by masking with chemical aerosols.

OUTFALL–(1) The point, location, or structure where wastewater or drainage discharges from a sewer, drain, or other conduit. (2) The conduit leading to the ultimate disposal area. Also see outfall sewer.

OUTFALL SEWER–A sewer that receives wastewater from a collecting system or from a treatment plant and carries it to a point of final discharge. See outfall.

OXIDATION PROCESS–Any method of wastewater treatment for the oxidation of the putrescible organic matter. The usual methods are biological filtration and the activated sludge process.

OZONE–Oxygen in molecular form with three atoms of oxygen forming each molecule (O_3). Used in odor control.

PARTS PER MILLION–The number of weight or volume units of a minor constituent present with each one million units of the major constituent of a solution or mixture. Formerly used to express the results of most water and wastewater analyses, but more recently replaced by the ratio milligrams per liter.

pH–A measure of the acidity or alkalinity of a solution. Expressed in terms of a scale from 0 to 14, a reading of 7 indicates neutrality, readings less than 7 increasing acidity, and greater than 7 increasing alkalinity.

POLLUTION–A condition created by the presence of harmful or objectionable material in water. Also see contamination.

POSTCHLORINATION–The application of chlorine to water or wastewater subsequent to any treatment, including prechlorination.

POTABLE WATER–Water that does not contain objectionable pollution, contamination, minerals, or infective agents and is considered satisfactory for domestic consumption.

PRELIMINARY TREATMENT–(1) The conditioning of a waste at its source before discharge, to remove or to neutralize substances injurious to sewers and treatment processes or to effect a partial reduction in load on the treatment process. (2) In the treatment process, unit operations, such as screening and comminution, that prepare the liquor for subsequent major operations.

PRESSURE-REDUCING VALVE–A valve with a horizontal disk for reducing pressures automatically, according to the setting of the pressure-regulating valves.

PRESSURE-REGULATING VALVE–A valve placed at either end of a pressure-regulating apparatus inserted in a water main to regulate the pressure in a water line either upstream or downstream from the valve.

PRESSURE-RELIEF VALVE–A valve that opens automatically to ample area, when the pressure reaches an assigned limit, to relieve the stress on a pipeline.

PRIMARY TREATMENT–(1) The first major (sometimes the only) treatment in a wastewater treatment works, usually sedimentation. (2) The removal of a substantial amount of suspended matter but little or no colloidal and dissolved matter.

PROPELLER PUMP–A centrifugal pump that develops most of its head by the propelling or lifting action of the vanes on the liquids. Also called axial flow pump.

RAW SLUDGE–Settled sludge promptly removed from sedimentation tanks before decomposition has much advanced. Frequently referred to as undigested sludge.

REGULATOR–(1) A structure installed in a canal, conduit, or channel to control the flow of water or wastewater at intake, or to control the water level in a canal, channel, or treatment unit. (2) A device for regulating the diversion of flow in combined sewers. (3) A device for regulating water pressure.

RELIEF SEWER–(1) A sewer built to carry the flows in excess of the capacity of an existing sewer. (2) A sewer intended to carry a portion of the flow from a district in which the existing sewers are of insufficient capacity, and thus prevent overtaxing the latter.

RELIEF VALVE–A valve that releases air from a pipeline automatically without loss of water, or introduces air into a line automatically if the internal pressure becomes less than that of the atmosphere.

RESIDUAL CHLORINE–Chlorine remaining in water or wastewater at the end of a specified contact period as combined or free chlorine.

RETURNED SLUDGE–Settled activated sludge returned to mix with incoming raw or primary settled wastewater.

SAMPLER–A device used with or without flow measurement to obtain an aliquot portion of water or waste for analytical purposes. May be designed for taking single sample (grab), composite sample, continuous sample, or periodic sample.

SANITARY SEWER–A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground , storm, and surface waters that are not admitted intentionally. See wastewater.

SANITARY WASTEWATER–(1) Domestic wastewater with storm and surface water excluded. (2) Wastewater discharging from the sanitary conveniences of dwellings (including apartment houses, and hotels), office buildings, industrial plants, or institutions. (3) The water supply of a community after it has been used and discharged into a sewer.

SECONDARY WASTEWATER TREATMENT–The treatment of wastewater by biological methods after primary treatment by sedimentation.

SEDIMENTATION–The process of subsidence and deposition of suspended matter carried by water, wastewater, or other liquids by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material. Also called settling.

SEDIMENTATION TANK–A basin or tank in which water or wastewater containing settleable solids is retained to remove by gravity a part of the suspended matter. Also called sedimentation basin, settling basin, settling tank.

SETTLEABLE SOLIDS–(1) That matter in wastewater which will not stay in suspension during a preselected settling period, such as one hour, but either settles to the bottom or floats to the top. (2) In the Imhoff cone test, the volume of matter that settles to the bottom of the cone in one hour.

SETTLING–The process of subsidence and deposition of suspended matter carried by water, wastewater, or other liquids by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material. Also called sedimentation.

SEWAGE–The spent water of a community. Term now being replaced in technical usage by preferable term wastewater. See wastewater.

SEWAGE GAS–(1) Gas resulting from the decomposition of organic matter in wastewater. (2) Gas produced during the digestion of sludge.

SEWERAGE–System of piping, with appurtenances, for collecting and conveying wastewater from source to discharge. Term declining in use. See sewer system.

SEWER GAS–(1) Gas evolved in sewers that results from the decomposition of the organic matter in the wastewater. (2) Any gas present in the wastewater system, even though it is from such sources as gas mains, gasoline, or cleaning fluid.

SEWER SYSTEM–Collectively, all of the property involved in the operation of a sewer utility. It includes land, wastewater lines and appurtenances, pumping stations, treatment works, and general property. Occasionally referred to as a sewerage system.

SIPHON–A closed conduit, a portion of which lies above the hydraulic grade line, resulting in a pressure less than atmospheric and requiring a vacuum within the conduit to start flow. A siphon utilizes atmospheric pressure to effect or increase the flow of water through the conduit.

SLUDGE–(1) The accumulated solids separated from the liquids, such as water or wastewater, during processing, or deposits on bottoms of streams or other bodies of water. (2) The precipitate resulting from chemical treatment, coagulation, or sedimentation of water or wastewater.

SLUDGE CAKE–The sludge that has been dewatered by a treatment process to a moisture content of 60 to 85 percent, depending on type of sludge and manner of treatment.

SLUDGE CONDITIONING–Treatment of liquid sludge before dewatering to facilitate dewatering and enhance drainability, usually by the addition of chemicals.

SLUDGE DEWATERING–The process of removing a part of the water in sludge by any method such as draining, evaporation, pressing, vacuum filtration, centrifuging, exhausting, passing between rollers, acid flotation, or dissolved-air flotation with or without heat. It involves reducing from a liquid to a spadable condition rather than merely changing the density of the liquid (concentration) on the one hand or drying (as in a kiln) on the other.

SLUDGE DIGESTION–The process by which organic or volatile matter in sludge is gasified, liquified, mineralized, or converted into more stable organic matter through the activities of either anaerobic or aerobic organisms.

SLUDGE TREATMENT–processing of wastewater sludges to render them innocuous. This may be done by aerobic or anaerobic digestion followed by drying on sand beds, filtering and incineration, filtering and drying, or wet air oxidation.

STORM SEWER–A sewer that carries storm water and surface water, street wash and other wash waters, and drainage but excludes domestic wastewater and industrial wastes. Also called storm drain.

SUPERCHLORINATION–Chlorination wherein the doses are deliberately selected to produce free or combined residuals so large as to require dechlorination.

SUSPENDED SOLIDS–(1) Solids that either float on the surface of, or are in suspension in, water, wastewater, or other liquids, and which are largely removable by laboratory filtering. (2) The quantity of material removed from wastewater in a laboratory test, as prescribed in "Standard Methods for the Examination of Water and Wastewater" and referred to as nonfilterable residue.

TOTAL SOLIDS–The sum of dissolved and undissolved constituents in water or wastewater, usually stated in milligrams per liter.

TREATED SEWAGE–Wastewater that has received partial or complete treatment.

TRUNK SEWER–A sewer that receives many tributary branches and serves a large territory. See main sewer.

VACUUM BREAKER–A device for relieving a vacuum or partial vacuum formed in a pipeline, thereby preventing backsiphonage.

VOLATILE SOLIDS–The quantity of solids in water, wastewater, or other liquids lost on ignition of the dry solids at 600°C.

WASTEWATER–The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. In recent years, the word wastewater has taken precedence over the word sewage.

Part II

The terms included in this section are those primarily associated with the Metro CATAD system as they affect wastewater operations.

ANALOG–The representation of a numerical quantity by some physical variable, e.g., translation, rotation, voltage, or resistance.

AUXILIARY CONTROL UNIT (ACU)–A cabinet containing electronics equipment, relays, etc. located between the TCU and station local control system.

COMPUTER AUGMENTED TREATMENT AND DISPOSAL SYSTEM (CATAD)–Metro's computer system at Metro's central office.

CATAD CONTROL UNIT (CCU)–A cabinet housing an ACU and TCU.

HARD COPY–A printed copy of machine output.

HARDWARE–The physical equipment and devices which comprise a computer or computer system component.

MODEM–A device which converts between computer-recognized signals and tones transmitted over telemetry lines.

OFF-LINE–The system and equipment under human operator control, not CPU control.

ON-LINE–The system and equipment under continuous automatic CPU control.

OUTFALL GATE CONTROLLER (OGC)–The cabinet containing controllers and recorders relating to the outfall gate at a mechanical regulator station.

PRIORITY–The degree of importance assigned to some computer tasks.

PROGRAM–A logical sequence of operations to be performed by a digital computer in solving a problem or in processing data.

REAL-TIME CONTROL–Control of a system by using computers and timing such that the speed of response to the input information is fast enough to effectively influence the performance of that system.

SCAN–The collection and storage of data from all points at all stations in the system by computer.

SOFTWARE–The programs or instructions which often control the hardware to perform some computer operation or extend the capabilities of the system.

TELEMETRY–Data transmission over long distances via telephone or telegraph lines by electromagnetic means.

TELEMETRY CONTROL UNIT (TCU)–Interchangeable electronic cabinets that convert between telemetry and station control signals (from ACU or CCU).

APPENDIX B –
DRAWING INDEX

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APPENDIX B
EAST MARGINAL WAY PUMPING STATION DRAWINGS INDEX

CONTRACT NO.	CONTRACT TITLE(S)
62-8	W210B – East Marginal Way Pumping Station
M3-74	Mods – East Marginal Way Pumping Station

APPENDIX C – METRIC CONVERSIONS

APPENDIX C
METRIC CONVERSIONS

The basic guide for metric equivalents is "Units of Expression for Wastes and Waste Treatment", Water Pollution Control Federation, Manual of Practice No. 6, 1967 (revision in process). This guide is supplemented by the "Standard Metric Practice Guide", Standard No. E380-70 of the American Society for Testing and Materials. Table I provides the standard Metric abbreviations used in this manual. Table II gives the common Metric equivalents; all rounding is done after conversion. Where WPCF and ASTM standards conflict, WPCF standards govern except as noted herein.

Common linear dimensions given in inches up through and including 12 inches are converted to millimeters. Dimensions greater than 12 inches are converted to centimeters. Linear dimensions given in feet are converted to meters.

Common mechanical pipe or pressure pipe lines and tubing through 12-inch nominal size are specified in accordance with Table III. The given Metric equivalents are the nominal outside diameter of the piping in inches converted to millimeters and rounded off to full millimeters. Pressure pipe larger than 12 inches and all gravity lines are converted to centimeter equivalents of the inside diameter of the pipe. Valves and other ancillary equipment normally specified by nominal pipe size are converted the same way. For instance, a 4-inch valve on mechanical pipe would be specified as 114-millimeter equivalent.

Table I. Metric Abbreviations

centimeters	cm	kilograms per square meter	kg/sq m
coulomb	C	kilometers	km
cubic	cu	kilovolts	kv
cubic centimeters	cu cm	kilowatts	kw
cubic meters, steres	cu m	kilowatt-hours	kwhr
cubic meters per day	cu m/day		
cubic meters per minute	cu m/min	liters	l
cubic meters per day per square meter	cu m/day/sq m	liters per second	l/sec (lps)
cycles per second, Hertz	Hz		
		meters	m
degrees Celsius (formerly centigrade)	^{o}C	metric tons	(spell out)
		micrograms	mg
grams	g	milliamperes	m)
grams per cubic meter	g/cu m	milliamperes	ma
grams per day per cubic meter	g/day/cu m	milligrams per liter, parts per million (concentration in water)	mg/l
grams per day per square meter.	g/day/sq m	millimeters	mm
grams per liter	g/l		
		newton-meter	N-m
hectare, square hectometer	ha		
Hertz	Hz	square centimeters	sq cm
		square kilometers	sq km
kilograms	kg	square meters	sq m
kilogram-calorie	kg-cal		
kilograms per square centimeter	kg/sq cm		

Note: Spell out units not on this list.

Table II. Metric Equivalents of Commonly Used English Units of Measurement

To Convert From	To	Multiply By	To Convert From	To	Multiply By
acre	ha	0.4047	gpm/sq ft	l/min/sq m	40.75
acre-ft	cu m	1233.5	hp (mechanical)	kw	.7457
amp-hr	C	3600	hp (electrical)	kw	.7460
Btu	kg-cal	0.2520	in	cm	2.5400
Btu/lb	kg-cal/kg	0.5555		mm	25.400
Btu/hr	kg-cal/hr	0.2520	lb	kg	.4536
bu	l	35.24	lb/day/acre-ft	g/day/cu m	.3677
	cu m	.035 24	lb/1000.cu ft	g/cu m	16.02
cfm	cu m/min	.028 32	lb/acre/day	g/day/sq m	.1121
cfs	cu m/min	1.6990	lb/day/cu ft	kg/day/cu m	16.02
cu ft	cu m	.028 32	lb/day/sq ft	g/day/sq m	4882
	l	28.32	lb/ft	kg/m	1.488
cu in	cu cm	16.39	lb/mil gal	g/cu m	0.1198
cu yd	cu m	.7646	mgd	cu m/day	3785
cycle per second	Hz	1.0000	mgd/acre	cu m/day/ha	9354
^{o}F	^{o}C	(F^{o}-32) x 0.5555	mile	km	1.609
fathom	m	1.829	ppb	mg/l	10^{-3}
ft	m	.304 80	pcf	kg/cu m	16.02
	cm	30.480	psf	kg/sq m	4.882
ft-c	lumen/sq m	10.764	psi	kg/sq cm	.070 31
ft-lb	N-m	1.356	sq ft	sq m	.092 90
gal	l	3.785	sq ft/cu ft	sq m/cu m	3.281
	cu m	.003 785	sq in	sq cm	6.452
gpd/acre	cu m/day/ha	.009 354	sq miles	sq km	2.590
gpd/ft	cu m/day/m	.012 42	tons (short)	kg	907.2
gpd/sq ft	cu m/day/sq m	.040 75		metric tons	.9072
gpm	l/sec	.063 09			

NOTE: Mechanical horsepower used for pumps, engines, and other mechanical equipment. Electrical horsepower used for electric motors.

Table III. Metric Equivalents of Pipe and Tubing

Size (inches nominal)	Mechanical Pipe Outside Diameter inches (nominal)	mm	Copper Tubing Outside Diameter inches (nominal)	mm	Size (inches nominal)	Mechanical Pipe Outside Diameter inches (nominal)	mm	Copper Tubing Outside Diameter inches (nominal)	mm
1/8	.405	10	(nonstandard)		2-1/2	2.875	73	2.625	66.7
1/4	.540	14	.375	9.5	3	3.500	89	3.125	79.4
3/8	.675	17	.500	12.7	3-1/2	4.000	102	3.625	92.1
1/2	.840	21	.625	15.9	4	4.500	114	4.125	104.8
5/8	(nonstandard)		.750	19.0	5	5.563	141	5.125	130.2
3/4	1.050	27	.875	22.2	6	6.625	168	6.125	155.6
1	1.315	33	1.125	28.6	8	8.625	219		
1-1/4	1.660	42	1.375	34.9	10	10.750	273		
1-1/2	1.900	48	1.625	41.3	12	12.750	324		
2	2.375	60	2.125	54.0					

APPENDIX D –
EMERGENCY INFORMATION

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APPENDIX D
EMERGENCY INFORMATION

INTRODUCTION

This appendix provides an emergency services and utilities contact list (table D-1), general Metro WPCD emergency procedures, and specific station emergency procedures. These are used during disasters and other abnormal situations to help safeguard lives and property, prevent serious damage to facilities, and minimize the effect on the community.

Equipment and systems emergency procedures are included in their respective manual sections. General by-pass/overflow procedures are found in the Administration and Maintenance section of this manual. Refer to Metro's annually revised Overflow Manual for more detailed information and reporting procedures.

EMERGENCY SERVICES AND UTILITIES CONTACT LIST

Table D-1 is a comprehensive listing of various troubles, the organization or individual and the phone number to contact for each, and pertinent comments.

GENERAL EMERGENCY PROCEDURES

During a disaster, Metro's primary purposes are to safeguard the public health by disposing of waste water from local sewerage systems, to place its available resources at the disposal of the Seattle-King County Civil Defense Organization for use in reestablishing facilities within the County and to coordinate pollution abatement procedures with local and state agencies, local utilities, and private industry.

The normal chain of command applies for all emergencies: natural, man-made, or wartime. Probable lack of communications may require individual plants and units to operate independently for considerable lengths of time, so it is important that operations personnel be familiar with emergency procedures and know where to get specific information quickly.

Natural Disaster

For Personnel on Duty. All mobile and fixed radio units shall be called by Base Station KBW 835 and alerted to stand by for instructions. Other areas and facilities will be contacted by phone if feasible. Personnel will take any necessary action to safeguard themselves and their equipment. When practical, supervisors shall tour their assigned areas, utilizing their personnel and equipment to repair or alleviate damage – reporting any conditions requiring additional help. Such conditions could include, but are not limited to, sewer and force main breaks, pipe breaks in pump stations, extensive tank and structural damage in treatment plants and outlying facilities. Field crews will be routed through Base Station KBW 835 as circumstances permit. In the event that base radio stations are rendered inoperable, supervisors will assume control by use of Metro radio cars, radio cars of other utilities, telephone, etc.

For Personnel Off Duty. Personnel will normally receive notification of the disaster by radio, television, newspaper, etc. They should take necessary steps to safeguard themselves and their families. Personnel garaging radio-equipped Metro vehicles at home shall man their radios as soon as possible and stand by for instructions.

After a natural disaster, pumping station and treatment plant flow will be bypassed as damage to facilities dictates. Normal service will be reestablished as soon as repairs can be made.

War

If possible, all personnel shall be warned of the impending situation by radio, telephone, Civil Defense or any other available means. Personnel will take immediate steps to safeguard themselves and their families. When conditions allow, personnel will follow the procedures as outlined under "Natural Disaster."

Pumping station, regulator station, and treatment plant flow will be bypassed after warning is received of a nuclear attack. Service will be reestablished as soon as the situation permits.

STATION EMERGENCY PROCEDURES

Table D-2 lists specific East Marginal Way pumping station emergency procedures. Normally, the responsible supervisor gives the order to implement emergency procedures. However, non-supervisory personnel may take action if the situation is serious enough and no other direction is available. See table D-1 for emergency telephone numbers and general emergency procedures.

Table D-1. Emergency Services and Utilities Contact List

TROUBLE OR REQUIREMENT	ORGANIZATION AND/OR INDIVIDUAL	TELEPHONE	COMMENT
EMERGENCY SERVICES:			
Fire	Seattle Fire Dept.	911	
Police	Seattle Police Dept.	911	
Ambulance	Medic 1	911	
UTILITIES:			
Power Failure	Seattle City Light	447-3300(1) 447-3000(2)	
Telemetry	Pacific Northwest Bell	345-3131	Call if fault persists for 5 minutes or longer. Report trouble on 4 kc 1559 network, line 1
Water	Seattle Water Dept.	583-5830	North of ship canal
	Seattle Water Dept.	583-2350	South of ship canal
Emergency Sewer Repair	Frank Coluccio Const. Co.	722-5306	To be called only by supervisor when unable to contact responsible persons from Construction Division
	Constructors-Pamco:		
	Dick Scheumann	633-5292	
	Doug Scheumann	632-6607	
ENVIRONMENT/HEALTH/ ECOLOGY:			
Overflow/Bypass Report	Dept. of Ecology:	885-1900	Notify West Point Division Superintendent or Assistant Superintendent first. If neither is available, the shift supervisor will contact personnel listed
	Robert K. McCormick, Regional Bus. Mgr.	232-2869 (home)	
	Stewart Messmann, District Engineer	633-1763 (home)	
	Dept. of Social and Health Services:	464-7672	
	Alvin G. Koch, District Engineer;	523-4487 (home)	
	Robert E. Leaver, Office Mgr.	522-8052 (home)	
	Seattle-King County	583-2537	

Table D-1. Emergency Services and Utilities Contact List (Cont.)

TROUBLE OR REQUIREMENT	ORGANIZATION AND/OR INDIVIDUAL	TELEPHONE	COMMENT
	Dept. of Public Health:		
	John Nardeen, Director of Operations;	525-8754 (home)	
	William Liening, Water Program Coord.	583-2065 (office), 746-4475 (home)	
	Metro Water Quality Division:		
	Glen Farris, Mgr.	447-6741 (office), 242-6886 (home)	
	Robert I. Matsuda, Ecological Analyst	447-6744 (office), 525-7461 (home)	
Oil Spills	Coast Guard Dispatcher	284-2361	
OTHER:			
Septic Tank Pumpers	Chapman Plumbing, 11003 17th Ave. SW, Seattle, WA (Mrs. Grace Chapman);	242-1413	Tanker capacity – 1,800 gal (6,800 l)
	Daniel's Moving, P. O. Box 1141, Lynnwood, WA 98036;	774-0509	Tanker capacity – 5,000 gal (18,950 l)
	G and N Septic Tank Service, 30663 Military Rd., Auburn, WA 98002 (Mr. M. L. Noyes)	839-1028	Tanker capacity – 1,350 gal (5,100 l) and 2,500 gal (9,475 l)
	J and W Septic Tank Service, 14007 6th Ave. S., Seattle, WA 98168 (Mr. Jerry Wick);	248-1264	Tanker capacity – 1,800 gal (6,800 l)
	Lyon Septic Tank Service, P. O. Box 127, Redmond, WA 98052 (Mr. Opie Hartman);	885-1300	Tanker capacity – 2,800 gal (10,600 l)
	United Services, 3450 16th Ave. W., Seattle, WA 98119 (Mr. Orvin Berg)	285-2191	Tanker capacity – 700 gal (2,650 l) (other unit available)
METRO:			
West Point Division Supervisory Personnel	West Point Treatment Plant	447-6801/ 6802/6803/ 284-6330	During working hours

Table D-1. Emergency Services and Utilities Contact List (Cont.)

TROUBLE OR REQUIREMENT	ORGANIZATION AND/OR INDIVIDUAL	TELEPHONE	COMMENT
West Point Division Maintenance Personnel on Emergency Call	Electrical/Instrumentation	977-3055	Bell Boy Numbers
	Mechanical	977-3051	
	Supervisor	977-2308	
South Area Supervisor	Duwamish Pumping Station	622-1628	
North Area Supervisor	Interbay Pumping Station	284-0130	
	Matthews Park Pumping Station	522-5892	
Renton Division Supervisory Personnel	Renton Treatment Plant	226-3680	During working hours
Extra Personnel in Emergency	Renton Treatment Plant	226-3680	Try to contact division superintendent or assistant superintendent
	City of Seattle, Charles Street Shops	583-2810	

Table D-2. Station Emergency Procedures

CONDITION	ACTION	TABLE	COMMENTS
1. Power failure	a. Request mobile generator from WPTP and connect to receptacle in control room (figure 5-2).	5-7	
	b. Close influent sluice gate, if necessary, to prevent flooding of wet well.	6-3	b. Depending on conditions, station storage time varies from 1/2 to 4 hours.
2. CATAD failure	a. Shut down TCU and insure that station operates in local automatic control mode. **Note** *The East Marginal Way pumping station cannot be bypassed. Failure of East Marginal or Duwamish pumping stations or line rupture between the two will eventually cause an overflow into the Duwamish River.*	4-4	a. Normally done by CATAD personnel, instrument technicians, or Engineering Services representatives only. See also table 4-1, Control System Alarm Indications.
3. RSP System Failure	a. Notify division maintenance section.		
	b. At Norfolk Street regulator station, fully open and lock in position both regulator and outfall gates.		
	c. Allow water level to rise in influent channel until WET WELL HIGH LEVEL alarm is triggered. Influent sluice gate should close automatically; if not, close gate manually.	6-3	c. Flow backs up through Norfolk Street regulator station regulator gate and into the Duwamish River through its outfall gate. Flow from Henderson Street trunk is also bypassed into Duwamish River instead of Lake Washington.
	d. Notify Renton Treatment Plant.		d. Depending on length of station inoperation, RTP may be able to divert or store all or part of its sludge flow.
	e. Complete a "Sewage Bypassing or Overflow Report", OP-40 if sewage does actually overflow into Duwamish River at either East Marginal Way pumping station or Norfolk Street regulator. See Section III for instructions.		

Table D-2. Station Emergency Procedures (Cont.)

CONDITION	ACTION	TABLE	COMMENTS
4. Line break downstream between East Marginal and Duwamish pumping stations or Duwamish pumping station failure or downstream overflow	a. At East Marginal Way pumping station, slow down raw sewage pumps, allow influent channel level to rise until WET WELL HIGH LEVEL alarm is triggered. Influent sluice gate should close automatically; if not, close gate manually, and shut down raw sewage pumps. b. At Norfolk Street regulator station, fully open and lock in position both regulator and outfall gates. WARNING *Observe all pertinent safety rules when working around open manholes or channels (refer to Section II).* c. (Optional). At effluent junction structure, install slide gates. d. Notify Renton Treatment plant. e. Complete "Sewage Bypassing or Overflow Report", OP-40.	7-7 7-6 6-3 6-3 7-10 6-6	a. See "COMMENTS" in condition 3 above. Additional emergency overflow capability may be provided by opening and locking regulator gates at Michigan and Brandon Street regulator stations.
5. Line break upstream between East Marginal Way pumping station and Norfolk Street regulator station	a. Notify WPTP and RTP. b. As influent channel level drops, verify that, at elevation 94.0, WET WELL LOW LEVEL alarm AL 4 is triggered and RSP system automatically shuts down. If RSP system does not shut down as programmed, do so manually.	7-7 7-6 7-10	

Table D-2. Station Emergency Procedures (Cont.)

CONDITION	ACTION	TABLE	COMMENTS
6. Upstream overflow	a. RSP system goes to maximum pumping capacity (all three pumps operating; CATAD locked out). If system does not speed up as programmed, do so manually. b. Notify RTP. **WARNING** *Don't be a hero! If there are any doubts or problems, get out of the building immediately, call the fire department (tel. 911), and wait outside until help arrives.*	7-7 7-6	b. See "COMMENT", condition 3, step d.
7. Fire	a. If fire is containable and extinguishable, use available fire extinguishers to do so. b. Notify supervisor and/or WPTP as soon as possible. **Note** *Check fire extinguishers monthly; if recharging is required, notify supervisor. Every six months, contact Day Service Crew for recharging.*	D-1	a. Fire extinguisher locations: • Inside control room door at head of motor room stairs. • Opposite main control panel above service sink. • In motor room on water tight wall near thermostats. • In wet well access room inside door.
8. Explosion hazard (EXPLOSION HAZARD MONITOR alarm AL 9 on)	a. Evacuate station immediately. b. Notify supervisor. If he is not available, notify Division Superintendent or Assistant Superintendent for Operations. They are responsible to take appropriate action.		